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TITLE: LUMINESCENT MATERIAL FOR ORGANIC  
ELECTROLUMINESCENT  
ELEMENT MADE BY ELEMENT AND ORGANIC ELECTROLUMINESCENT  
USING IT  
PUBN-DATE: September 22, 1998

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INT-CL (IPC): C09K011/06

ABSTRACT:

PROBLEM TO BE SOLVED: To improve the luminous intensity, luminous efficiency, and stability in repeated use by reacting a dihalide of a specified divalent residue, a secondary amine derivative, potassium carbonate and a catalyst in a solvent.

SOLUTION: A dihalide of a divalent residue represented by A in formula I is

reacted with a secondary amine derivative having a structure wherein the N-A bond of formula I is substituted by H, potassium carbonate and a catalyst in a solvent to give a luminescent material for an organic electroluminescent element, represented by formula I [wherein A is, e.g. an (un)substituted aromatic group, an (un)substituted condensed aromatic group [except for groups of formula II (wherein E is H, or adjacent E's may be combined to form a new six-membered aromatic ring)], or a divalent group linked through at least one nonaromatic structural unit (except for the case of formula III); Ar<sub>1</sub> to Ar<sub>4</sub> are each an (un)substituted aromatic group, or an (un)substituted condensed aromatic group; x<sub>1</sub> to x<sub>4</sub> are each -O-, -S-, >C=O, etc.; and R<sub>1</sub> to R<sub>20</sub> are each H, halogeno, an (un)substituted alkyl, an (un)substituted alkoxy, etc.].

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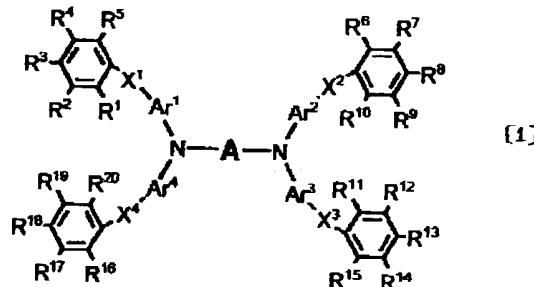
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(54)【発明の名称】 有機エレクトロルミネッセンス素子用発光材料およびそれを使用した有機エレクトロルミネッセンス素子

(57)【要約】 (修正有)

【課題】 輝度・効率・信頼性の高い、発光劣化の少ない有機エレクトロルミネッセンス(EL)素子用発光材料とそれを使用した有機EL素子を提供する。

【解決手段】 一般式1の有機EL素子用発光材料。



O<sub>2</sub>、-(C<sub>x</sub>H<sub>2x</sub>)-O-(C<sub>y</sub>H<sub>2y</sub>)-、アルキリデン、アルキレン、2価の脂肪族環基(x、yは0~2の整数を表すがx+y=0ではない。)。R<sup>1</sup>~R<sup>20</sup>は水素、ハロゲン、アルキル、アルコキシ、芳香環、複素芳香環、アミノ基を表す(R<sup>1</sup>~R<sup>5</sup>、R<sup>6</sup>~R<sup>10</sup>、R<sup>11</sup>~R<sup>15</sup>、R<sup>16</sup>~R<sup>20</sup>は隣接置換基同士で結合して環を形成しても良い。)。】

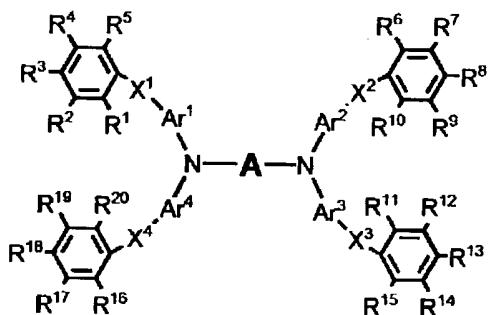
[Aは芳香環、縮合芳香環、複素芳香環、縮合複素芳香環基またはそれらの同じか異なる2種以上の環が2~10個直接もしくは酸素、窒素、硫黄、C1~20個でヘテロ原子を含んでも良い鎖、非芳香環の1個以上を介して連結した2価の基、Ar<sup>1</sup>~Ar<sup>4</sup>は芳香環、縮合芳香環基、X<sup>1</sup>~X<sup>4</sup>は-O-、-S-、>C=O、>S

## 【特許請求の範囲】

【請求項1】 下記一般式[1]で示される有機エレクトロルミネッセンス素子用発光材料。

一般式[1]

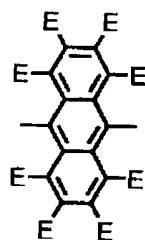
【化1】



[式中、Aは置換もしくは未置換の芳香環基、置換もしくは未置換の縮合芳香環基（ただし、下記一般式[2]を除く）、置換もしくは未置換の複素芳香環基、置換もしくは未置換の複素芳香環基、またはそれらの同種または異なる2種以上の環構造単位が2～10個直接もしくは酸素原子、窒素原子、硫黄原子、炭素数1～20個でヘテロ原子を含んでも良い鎖状構造単位、非芳香環構造単位の少なくとも1個を介して連結した2価の基を表す（ただし、下記一般式[3]である場合を除く。）。Ar<sup>1</sup>～Ar<sup>5</sup>は、それぞれ独立に、置換もしくは未置換の芳香環基、置換もしくは未置換の縮合芳香環基を表す。X<sup>1</sup>～X<sup>4</sup>は、それぞれ独立に、-O-、-S-、>C=O、>SO<sub>2</sub>、-(C<sub>x</sub>H<sub>2x</sub>)-O-(C<sub>y</sub>H<sub>2y</sub>)-、置換もしくは未置換の炭素数2～20のアルキリデン基、置換もしくは未置換の炭素数2～20のアルキレン基、置換もしくは未置換の2価の脂肪族環基を表す（ここで、x、yは、それぞれ0～20の整数を表すが、x+y=0となることはない。）。R<sup>1</sup>～R<sup>20</sup>は、それぞれ独立に、水素原子、ハロゲン原子、置換もしくは未置換のアルキル基、置換もしくは未置換のアルコキシ基、置換もしくは未置換の芳香環基、置換もしくは未置換の複素芳香環基、置換もしくは未置換のアミノ基を表す（R<sup>1</sup>～R<sup>5</sup>、R<sup>6</sup>～R<sup>10</sup>、R<sup>11</sup>～R<sup>15</sup>もしくはR<sup>16</sup>～R<sup>20</sup>は隣接した置換基同士で結合して新たな環を形成しても良い。）。]

一般式[2]

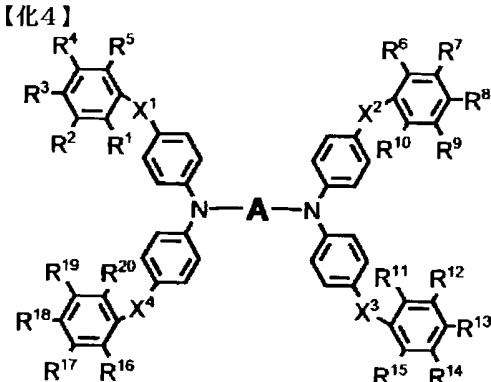
【化2】



（Eは水素原子または任意の隣接したE同士で結合して

10 【請求項2】 下記一般式[4]で示される請求項1記載の有機エレクトロルミネッセンス素子用発光材料。

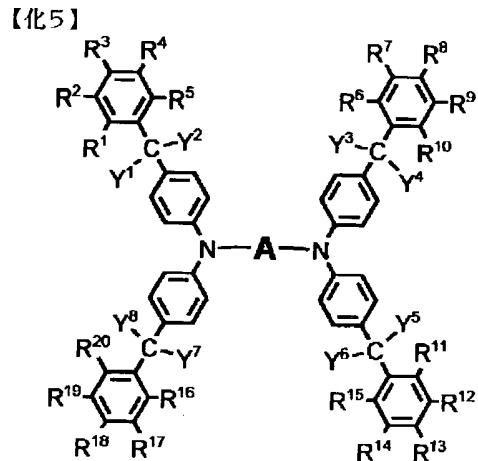
一般式[4]



[式中、A、X<sup>1</sup>～X<sup>4</sup>およびR<sup>1</sup>～R<sup>20</sup>は、それぞれ上記で定義したものと同じ意味を表わす。]

【請求項3】 下記一般式[5]で示される請求項2記載の有機エレクトロルミネッセンス素子用発光材料。

一般式[5]



[式中、AおよびR<sup>1</sup>～R<sup>20</sup>は、それぞれ上記で定義したものと同じ意味を表わす。Y<sup>1</sup>～Y<sup>8</sup>は、置換もしくは未置換の炭素数1～20のアルキル基、置換もしくは未置換の炭素数6～16の芳香族環基を表す（Y<sup>1</sup>とY<sup>2</sup>、Y<sup>3</sup>とY<sup>4</sup>、Y<sup>5</sup>とY<sup>6</sup>、Y<sup>7</sup>とY<sup>8</sup>で、置換もしくは未置換の炭素数5～7の脂肪族環基を形成しても良い。）。]

50 【請求項4】 一对の電極間に発光層または発光層を含

む複数層の有機化合物薄膜を形成してなる有機エレクトロルミネッセンス素子において、発光層が請求項1ないし3いずれか記載の有機エレクトロルミネッセンス素子用発光材料を含有する層である有機エレクトロルミネッセンス素子。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は平面光源や表示に使用される有機エレクトロルミネッセンス(EL)素子用発光材料および高輝度の発光素子に関するものである。

【0002】

【従来の技術】有機物質を使用したEL素子は、固体発光型の安価な大面积フルカラー表示素子としての用途が有望視され、多くの開発が行われている。一般にELは、発光層および該層をはさんだ一对の対向電極から構成されている。発光は、両電極間に電界が印加されると、陰極側から電子が注入され、陽極側から正孔が注入される。さらに、この電子が発光層において正孔と再結合し、エネルギー準位が伝導帯から価電子帯に戻る際にエネルギーを光として放出する現象である。

【0003】従来の有機EL素子は、無機EL素子に比べて駆動電圧が高く、発光輝度や発光効率も低かった。また、特性劣化も著しく実用化には至っていなかった。近年、10V以下の低電圧で発光する高い蛍光量子効率を持った有機化合物を含有した薄膜を積層した有機EL素子が報告され、関心を集めている(アプライド・フィジクス・レターズ、51巻、913ページ、1987年参照)。この方法は、金属キレート錯体を発光層、アミン系化合物を正孔注入層に使用して、高輝度の緑色発光を得ており、6~7Vの直流電圧で輝度は数1000cd/m<sup>2</sup>、最大発光効率は1.51m/Wを達成して、実用領域に近い性能を持っている。

【0004】しかしながら、現在までの有機EL素子は、構成の改善により発光強度は改良されているが、未だ充分な発光輝度は有していない。また、繰り返し使用時の安定性に劣るという大きな問題を持っている。これは、例えば、トリス(8-ヒドロキシキノリナート)アルミニウム錯体等の金属キレート錯体が、電界発光時に化学的に不安定であり、陰極との密着性も悪く、短時間の発光で大きく劣化していた。以上の理由により、高い発光輝度、発光効率を持ち、繰り返し使用時の安定性の優れた有機EL素子の開発のために、優れた発光能力を有し、耐久性のある発光材料の開発が望まれている。

【0005】

【発明が解決しようとする課題】本発明は、発光輝度が高く、繰り返し使用時の安定性の優れた有機EL素子の提供にある。本発明者らが観察検討した結果、一般式[1]、一般式[4]または一般式[5]のいずれかで示される有機EL素子用発光材料を発光層に使用した有機EL素子の発光輝度および発光効率が高く、繰り返し

使用時での安定性も優れていることを見いたし本発明を成すに至った。

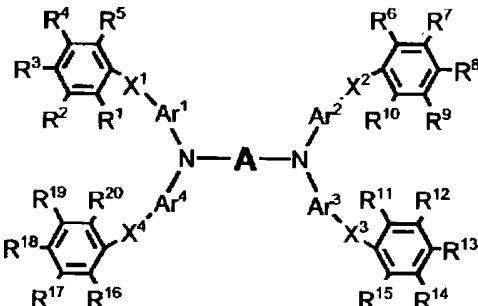
【0006】

【課題を解決するための手段】本発明は、下記一般式[1]で示される有機エレクトロルミネッセンス素子用発光材料に関する。

一般式[1]

【0007】

【化6】

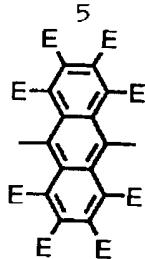


【0008】[式中、Aは置換もしくは未置換の芳香環基、置換もしくは未置換の縮合芳香環基(ただし、下記一般式[2]を除く)、置換もしくは未置換の複素芳香環基、置換もしくは未置換の縮合複素芳香環基、またはそれらの同種または異なる2種以上の環構造単位が2~10個直接もしくは酸素原子、窒素原子、硫黄原子、炭素数1~20個でヘテロ原子を含んでも良い鎖状構造単位、非芳香環構造単位の少なくとも1個を介して連結した2価の基を表す(ただし、下記一般式[3]である場合を除く。)。Ar<sup>1</sup>~Ar<sup>4</sup>は、それぞれ独立に、置換もしくは未置換の芳香環基、置換もしくは未置換の縮合芳香環基を表す。X<sup>1</sup>~X<sup>4</sup>は、それぞれ独立に、-O-、-S-、>C=O、>SO<sub>2</sub>、-(C<sub>x</sub>H<sub>2x</sub>)-O-(C<sub>y</sub>H<sub>2y</sub>)-、置換もしくは未置換の炭素数2~20のアルキリデン基、置換もしくは未置換の炭素数2~20のアルキレン基、置換もしくは未置換の2価の脂肪族環基を表す(ここで、x、yは、それぞれ0~20の整数を表すが、x+y=0となることはない。)。R<sup>1</sup>~R<sup>20</sup>は、それぞれ独立に、水素原子、ハロゲン原子、置換もしくは未置換のアルキル基、置換もしくは未置換のアルコキシ基、置換もしくは未置換の芳香環基、置換もしくは未置換の複素芳香環基、置換もしくは未置換のアミノ基を表す(R<sup>1</sup>~R<sup>5</sup>、R<sup>6</sup>~R<sup>10</sup>、R<sup>11</sup>~R<sup>15</sup>もしくはR<sup>16</sup>~R<sup>20</sup>は隣接した置換基同士で結合して新たな環を形成しても良い。)。]

一般式[2]

【0009】

【化7】

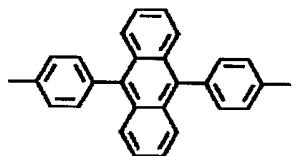


【0010】(Eは水素原子または任意の隣接したE同士で結合して新たな6員芳香族環を形成しても良い。)

一般式【3】

【0011】

【化8】

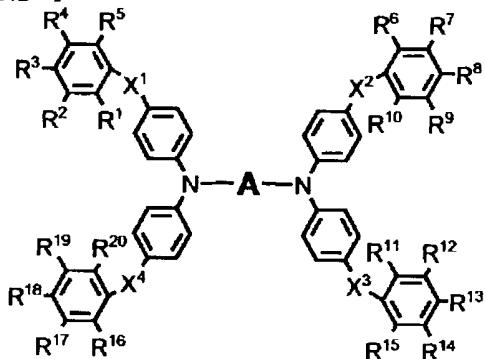


【0012】更に本発明は、下記一般式【4】で示される上記有機エレクトロルミネッセンス素子用発光材料に関する。

一般式【4】

【0013】

【化9】



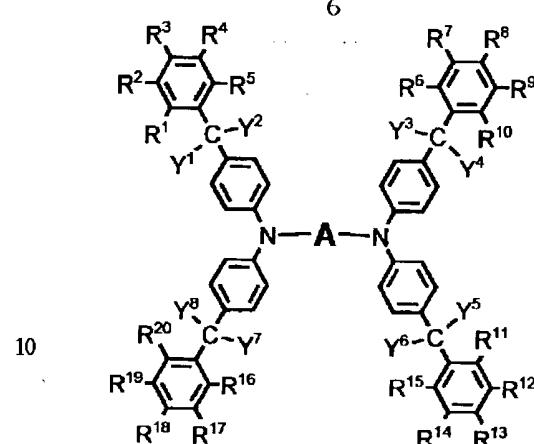
【0014】[式中、A、X<sup>1</sup>～X<sup>4</sup> およびR<sup>1</sup>～R<sup>20</sup>は、それぞれ上記で定義したものと同じ意味を表わす。]

【0015】更に本発明は、下記一般式【5】で示される上記有機エレクトロルミネッセンス素子用発光材料に関する。

一般式【5】

【0016】

【化10】



【0017】[式中、AおよびR<sup>1</sup>～R<sup>20</sup>は、それぞれ上記で定義したものと同じ意味を表わす。Y<sup>1</sup>～Y<sup>8</sup>は、置換もしくは未置換の炭素数1～20のアルキル基、置換もしくは未置換の炭素数6～16の芳香族環基を表す(Y<sup>1</sup>とY<sup>2</sup>、Y<sup>3</sup>とY<sup>4</sup>、Y<sup>5</sup>とY<sup>6</sup>、Y<sup>7</sup>とY<sup>8</sup>で、置換もしくは未置換の炭素数5～7の脂肪族環基を形成しても良い。)。]

【0018】更に本発明は、一对の電極間に発光層または発光層を含む複数層の有機化合物薄膜を形成してなる有機エレクトロルミネッセンス素子において、上記有機エレクトロルミネッセンス素子用発光材料を含有する層である有機エレクトロルミネッセンス素子に関する。

【発明の実施の形態】

【0019】本発明における一般式【1】、一般式【4】または一般式【5】で示される化合物のAは置換もしくは未置換の2価の芳香環基、縮合芳香環基、複素芳香環基、縮合複素芳香環基、あるいはそれらの同種または異なる2種以上の環構造単位が2～10個直接ないしは1個の炭素、酸素、窒素、硫黄原子または炭素鎖、ヘテロ原子を含む鎖状もしくは非芳香環構造単位を介して連結した2価の基を表す。ここで、Aの窒素原子に結合する部位は環構造を有する。

【0020】Aの具体例としては、ベンゼン、トルエン、キシレン、エチルベンゼン、ナフタレン、アントラゼン(ただし、9、10一位に結合する場合を除く)、フェナントレン、フルオレン、ビレン、クリセン、ナフタセン、ペリレン、アズレン、フルオレノン、アントラキノン、ジベンゾスベレノン、テトラシアノキノジメタン等の置換もしくは未置換の芳香族環もしくは縮合芳香環の2価の残基、ないしは、フラン、チオフエン、ピロール、ピリジン、ピロン、オキサゾール、ピラジン、オキサジアゾール、トリアゾール、チアジアゾール、インドール、キノリン、イソキノリン、カルバゾール、アクリジン、チオキサントン、クマリン、アクリドン、ジフェニレンスルホン、キノキサリン、ベンゾチアゾール、フェナジン、フェナントロリン、フェノチアジン、キナクリドン、フラバンスロン、インダンスロン等の複素芳

香環もしくは結合複素芳香環の2価の残基である。さらには、ビフェニル、ターフェニル、ビナフチル、ビフルオレニリデン、ビピリジン、ビキノリン、フラボン、フェニルトリアジン、ビスベンゾチアゾール、ビチオフェン、フェニルベンゾトリアゾール、フェニルベンズイミダゾール、フェニルアクリジン、ビス(ベンゾオキサゾリル)チオフェン、ビス(フェニルオキサゾリル)ベンゼン、ビフェニリルフェニルオキサジアゾール、ジフェニルベンゾキノン、ジフェニルイソベンゾフラン、ジフェニルピリジン、スチルベン、ジベンジル、ジフェニルメタン、ビス(フェニルイソプロピル)ベンゼン、ジフェニルフルオレン、ジフェニルヘキサフルオロプロパン、ジベンジルナフチルケトン、ジベンジリデンシクロヘキサン、ジスチリルナフタレン、(フェニルエチル)ベンジルナフタレン、ジフェニルエーテル、メチル\*

\*ジフェニルアミン、ベンゾフェノン、安息香酸フェニル、ジフェニル尿素、ジフェニルスルフィド、ジフェニルスルホン、ジフェノキシビフェニル、ビス(フェノキシフェニル)スルホン、ビス(フェノキシフェニル)プロパン、ジフェノキシベンゼン、エチレングリコールジフェニルエーテル、ネオベンチルグリコールジフェニルエーテル、ジビコリルアミン、ジビリジルアミン等の同種または異なる2種以上の環構造単位が2個以上連結した骨格を有する2価の残基である。

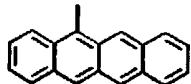
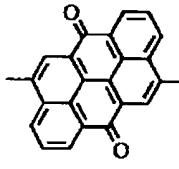
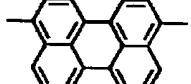
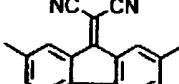
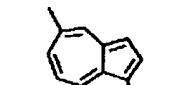
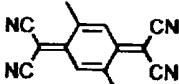
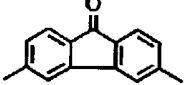
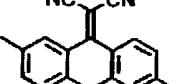
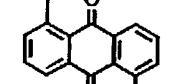
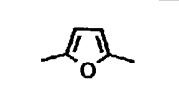
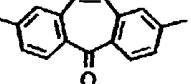
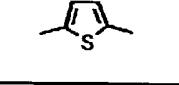
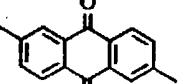
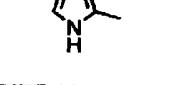
10 【0021】以下に、本発明の発光材料であるの化合物のAの構造の代表例を、表1に具体的に例示するが、本発明は、この代表例に限定されるものではない。

【0022】

【表1】

2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-1)		(A-9)	
(A-2)		(A-10)	
(A-3)		(A-11)	
(A-4)		(A-12)	
(A-5)		(A-13)	
(A-6)		(A-14)	
(A-7)		(A-15)	
(A-8)			

【0023】

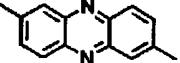
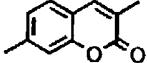
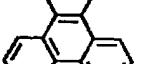
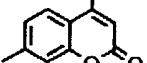
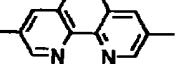
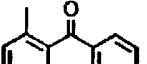
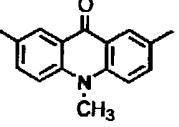
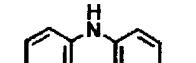
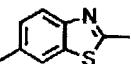
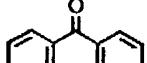
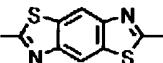
2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-16)		(A-23)	
(A-17)		(A-24)	
(A-18)		(A-25)	
(A-19)		(A-26)	
(A-20)		(A-27)	
(A-21)		(A-28)	
(A-22)		(A-29)	

【0024】

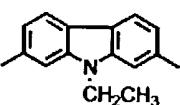
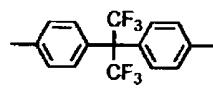
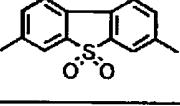
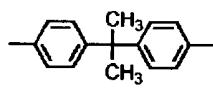
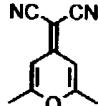
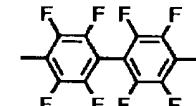
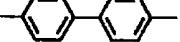
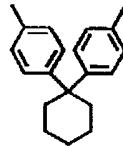
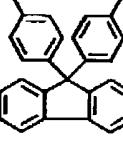
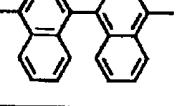
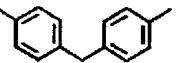
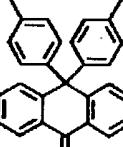
11

2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-30)		(A-38)	
(A-31)		(A-39)	
(A-32)		(A-40)	
(A-33)		(A-41)	
(A-34)		(A-42)	
(A-35)		(A-43)	
(A-36)		(A-44)	
(A-37)		(A-45)	

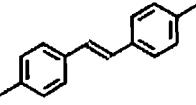
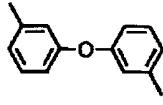
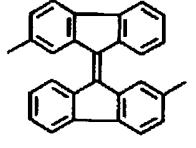
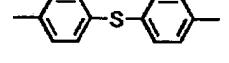
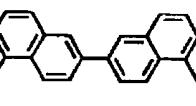
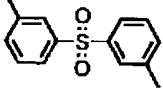
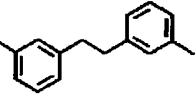
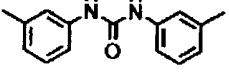
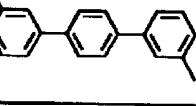
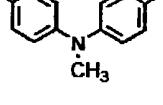
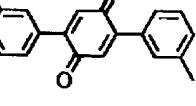
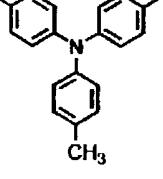
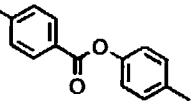
【0025】

2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-46)		(A-54)	
(A-47)		(A-55)	
(A-48)		(A-56)	
(A-49)			
(A-50)		(A-57)	
(A-51)		(A-58)	
(A-52)		(A-59)	
(A-53)		(A-60)	

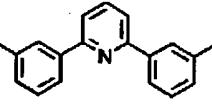
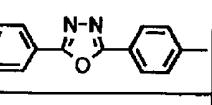
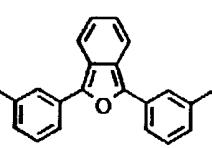
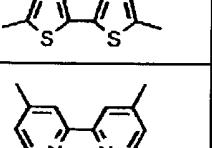
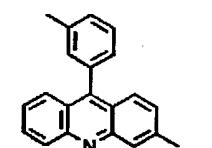
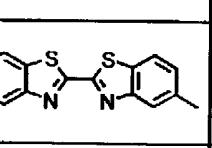
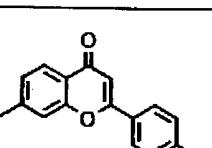
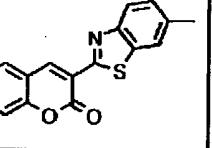
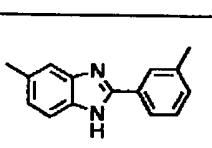
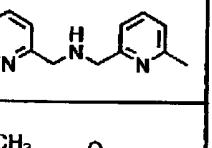
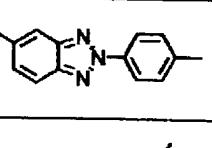
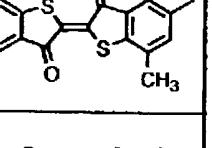
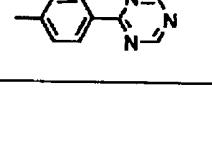
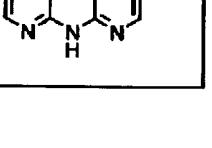
【0026】

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(A-61)		(A-69)	
(A-62)		(A-70)	
(A-63)		(A-71)	
(A-64)			
(A-65)		(A-72)	
(A-66)		(A-73)	
(A-67)			
(A-68)		(A-74)	

【0027】

2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-75)		(A-82)	
(A-76)		(A-83)	
(A-77)		(A-84)	
(A-78)		(A-85)	
(A-79)		(A-86)	
(A-80)		(A-87)	
(A-81)			

【0028】

2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-88)		(A-95)	
(A-89)		(A-96)	
(A-90)		(A-97)	
(A-91)		(A-98)	
(A-92)		(A-100)	
(A-93)		(A-101)	
(A-94)		(A-102)	

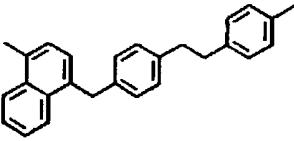
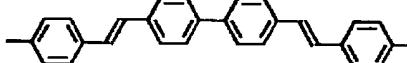
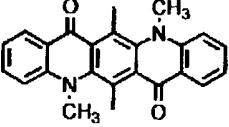
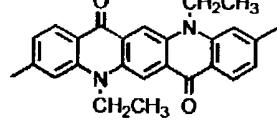
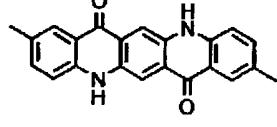
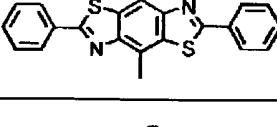
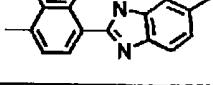
【0029】

2価基	化 学 構 造 (-A-)
(A-103)	
(A-104)	
(A-105)	
(A-106)	
(A-107)	
(A-108)	

【0030】

2価基	化学構造(-A-)
(A-109)	
(A-110)	
(A-111)	
(A-112)	
(A-113)	
(A-114)	
(A-115)	
(A-116)	

【0031】

2価基	化 学 構 造 (-A-)
(A-117)	
(A-118)	
(A-119)	
(A-120)	
(A-121)	
(A-122)	
(A-123)	

【0032】

2価基	化 学 構 造 (-A-)
(A-124)	
(A-125)	
(A-126)	
(A-127)	
(A-128)	
(A-129)	

【0033】

2価基	化学構造(-A-)
(A-130)	
(A-131)	
(A-132)	
(A-133)	
(A-134)	
(A-135)	

【0034】

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2価基	化学構造 (-A-)
(A-136)	
(A-137)	
(A-138)	
(A-139)	
(A-140)	

【0035】本発明における一般式〔1〕で示される化合物の  $A^{r1} \sim A^{r4}$  は、それ各自立に、置換もしくは未置換の2価の芳香環基、置換もしくは未置換の縮合芳香環基を表す。  $A^{r1} \sim A^{r4}$  の具体例は、ベンゼン、トルエン、キシレン、エチルベンゼン、ナフタレン、アントラゼン、フェナントレン、フルオレン、ビレン、クリセン、ナフタセン、ペリレン、アズレン等の置換もしくは未置換の芳香族環もしくは縮合芳香環の2価の残基である。また、一般式〔1〕、一般式〔4〕または一般式〔5〕で示される化合物の  $R^1 \sim R^{20}$  は、それ各自立に、水素原子、ハロゲン原子、置換もしくは未置換のアルキル基、置換もしくは未置換のアルコキシ基、置換もしくは未置換のアリール基、置換もしくは未置換のアミノ基を表す。

【0036】AないしはAr<sup>1</sup>～Ar<sup>4</sup>の有する置換基、およびR<sup>1</sup>～R<sup>20</sup>の具体例は、ハロゲン原子としては弗素、塩素、臭素、ヨウ素、置換もしくは未置換のA\*50

\*ルキル基としては、メチル基、エチル基、プロピル基、ブチル基、sec-ブチル基、tert-ブチル基、ベニチル基、ヘキシル基、ヘプチル基、オクチル基、ステアリル基、2-フェニルイソプロピル基、トリクロロメチル基、トリフルオロメチル基、ベンジル基、 $\alpha$ -フェノキシベンジル基、 $\alpha$ 、 $\alpha$ -ジメチルベンジル基、 $\alpha$ 、  
 40  $\alpha$ -メチルフェニルベンジル基、 $\alpha$ 、 $\alpha$ -ジトリフルオロメチルベンジル基、トリフェニルメチル基、 $\alpha$ -ベンジルオキシベンジル基等がある。置換もしくは未置換のアルコキシル基としては、メトキシ基、エトキシ基、プロポキシ基、n-ブトキシ基、t-ブトキシ基、n-オクチルオキシ基、t-オクチルオキシ基、1, 1, 1-テトラフルオロエトキシ基、フェノキシ基、ベンジルオキシ基、オクチルフェノキシ基等がある。置換もしくは未置換のアリール基としては、フェニル基、2-メチルフェニル基、3-メチルフェニル基、4-メチルフェニル基、4-エチルフェニル基、ビフェニル基、4-メチ

33

ルビフェニル基、4-エチルビフェニル基、4-シクロヘキシルビフェニル基ターフェニル基、3, 5-ジクロロフェニル基、ナフチル基、5-メチルナフチル基、アントリル基、ビレニル基等がある。置換もしくは未置換のアミノ基としては、アミノ基、ジメチルアミノ基、ジエチルアミノ基、フェニルメチルアミノ基、ジフェニルアミノ基、ジトリルアミノ基、ジベンジルアミノ基等がある。また、隣接する置換基同士で、それぞれ互いに結合して、置換もしくは未置換の、シクロペンテン環、シクロヘキセン環、フェニル環、ナフタレン環、アントラセン環、ビレン環、フルオレン環、フラン環、チオフェン環、ピロール環、オキサゾール環、チアゾール環、イミダゾール環、ピリジン環、ピラジン環、ピロリン環、ピラゾリン環、インドール環、キノリン環、キノキサン環、キサンテン環、カルバゾール環、アクリジン環、フェナントロリン環等を新たに形成しても良い。

【0037】本発明における一般式〔1〕または一般式〔4〕で示される化合物の $X^1 \sim X^4$ は、それぞれ独立に、 $-O-$ 、 $-S-$ 、 $>C=O$ 、 $>SO_2$ 、 $-(C_x H_{2x})-O-(C_y H_{2y})-$ 、置換もしくは未置換の炭素数2以上のアルキリデン基、置換もしくは未置換の炭素数2以上のアルキレン基、置換もしくは未置換の脂肪族

10 20

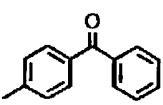
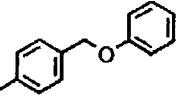
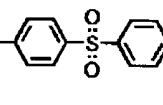
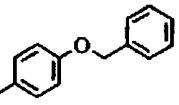
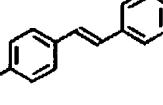
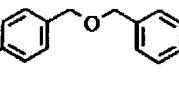
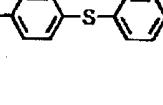
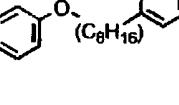
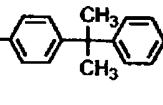
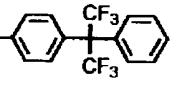
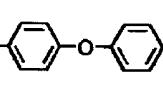
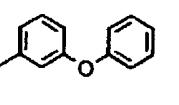
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環の2価の基を表す。ここで、 $x$ 、 $y$ は、0~20の正の整数を表すが、 $x+y=0$ となることはない。本発明における一般式〔5〕で示される化合物の $Y^1 \sim Y^8$ は、置換もしくは未置換の炭素数1~20のアルキル基、置換もしくは未置換の炭素数6~16の芳香族環基を表す。また、 $Y^1$ と $Y^2$ 、 $Y^3$ と $Y^4$ 、 $Y^5$ と $Y^6$ 、 $Y^7$ と $Y^8$ で、置換もしくは未置換の炭素数5~7の脂肪族環基を形成しても良い。アルキル基および芳香族環基の具体例は、前記の $R^1 \sim R^{20}$ で記述したアルキル基および芳香族環基が挙げられる。また、形成して良い炭素数5~7の脂肪族環基は、シクロペンチル基、シクロヘキシル基、4-メチルシクロヘキシル基、シクロヘプチル基等が挙げられる。

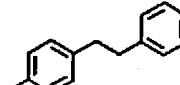
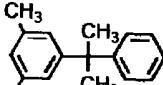
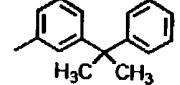
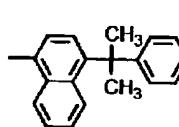
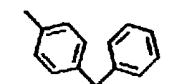
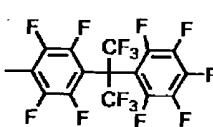
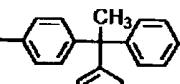
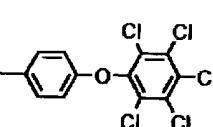
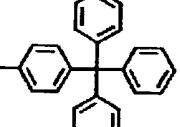
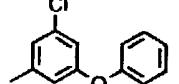
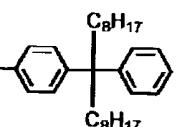
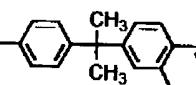
【0038】以下に、本発明の一般式〔1〕、一般式〔4〕または一般式〔5〕の化合物の窒素原子の外側の基（一般式〔1〕における、置換もしくは未置換のベンゼン環 $-X^n-Ar^n-$ の部分）の代表例を、表2に具体的に例示するが、本発明は、この代表例に限定されるものではない。

【0039】

【表2】

1価基	化 学 構 造	1価基	化 学 構 造
(B-1)		(B-7)	
(B-2)		(B-8)	
(B-3)		(B-9)	
(B-4)		(B-10)	
(B-5)		(B-11)	
(B-6)		(B-12)	

【0040】

1価基	化 学 構 造	1価基	化 学 構 造
(B-13)		(B-19)	
(B-14)		(B-20)	
(B-15)		(B-21)	
(B-16)		(B-22)	
(B-17)		(B-23)	
(B-18)		(B-24)	

【0041】

1価基	化 学 構 造
(B-25)	
(B-26)	
(B-27)	
(B-28)	
(B-29)	
(B-30)	

【0042】本発明における化合物は分子量の大きな嵩高い基を有するため、ガラス転移点や融点が高くなる。またR<sup>1</sup>～R<sup>20</sup>の隣接する置換基同士で芳香族環を形成している化合物は、さらにガラス転移点や融点が高くなる。このため、電界発光時における有機層中、有機層間もしくは、有機層と金属電極間で発生するジュール熱に対する耐性(耐熱性)が向上するので、有機EL素子の発光材料として使用した場合、高い発光輝度を示し、長時間発光させる際に有利である。

【0043】本発明の一般式[1]、一般式[4]、または一般式[5]で示される化合物の一般的な合成方法を以下に示す。一般式[1]、一般式[4]、または一般式[5]のAに当たる2価の残基のジハロゲン化物、一般式[1]、一般式[4]または一般式[5]の窒素原子とAとの結合を水素で置換した構造である2級アミン誘導体、炭酸カリウムおよび触媒を溶媒中で反応させ\*

\*で、一般式[1]、一般式[4]または一般式[5]の化合物を合成することができる。A構造のジハロゲン化物に代えてA構造のジカルボニル化合物から合成できるものもある。炭酸カリウムに代えて、炭酸ナトリウム、水酸化カリウム、水酸化ナトリウムまたはアンモニア水等を使用することができる。触媒としては、銅粉、塩化第一銅、スズ、塩化第一スズ、ピリジン、三塩化アルミニウムまたは四塩化チタンがある。溶媒は、ベンゼン、トルエンまたはキシレンがある。以上の合成法は一例であり、特に限定されるものではない。

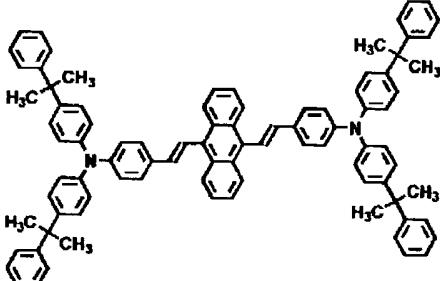
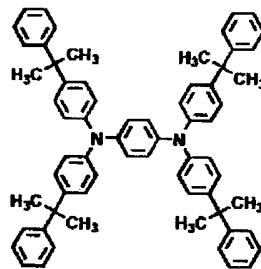
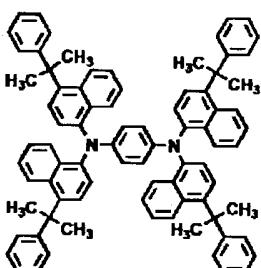
【0044】以下に、本発明の発光材料の代表例を、表3に具体的に例示するが、本発明は、この代表例に限定されるものではない。

【0045】

【表3】

化合物	化 学 構 造
(1)	
(2)	
(3)	

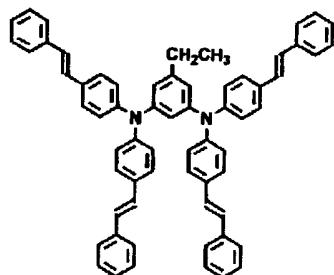
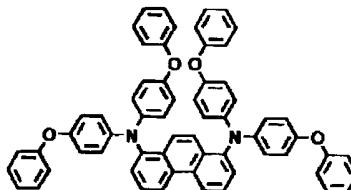
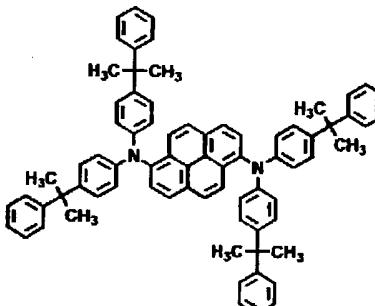
【0046】

化合物	化 学 構 造
(4)	
(5)	
(6)	

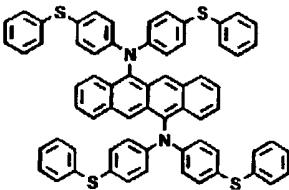
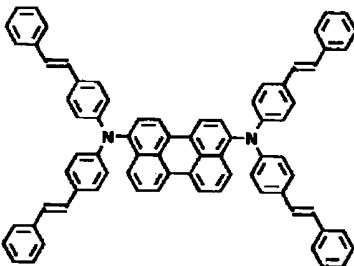
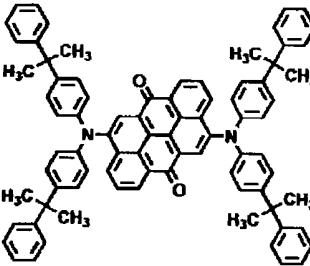
【0047】

化合物	化 学 構 造
(7)	
(8)	
(9)	

【0048】

化合物	化 学 構 造
(10)	
(11)	
(12)	

【0049】

化合物	化 学 構 造
(13)	
(14)	
(15)	

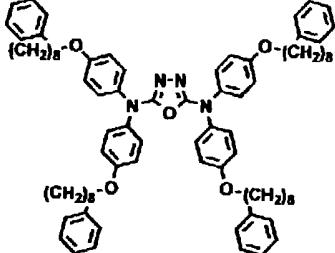
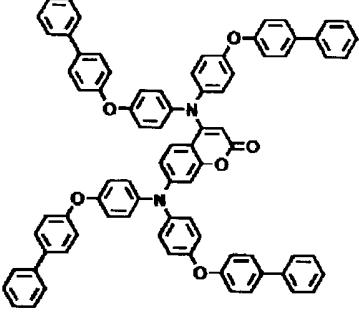
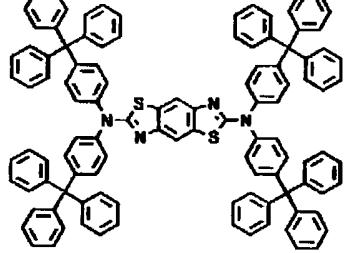
【0050】

化合物	化 学 構 造
(16)	
(17)	
(18)	

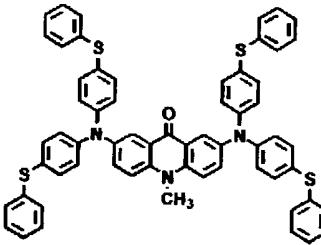
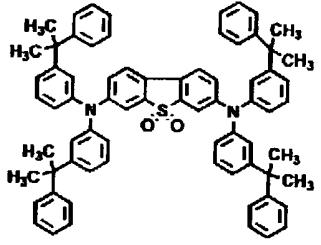
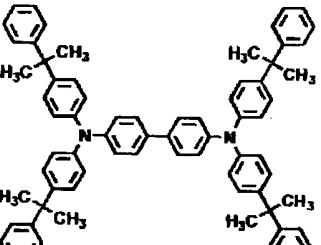
【0051】

化合物	化 学 構 造
(19)	
(20)	
(21)	

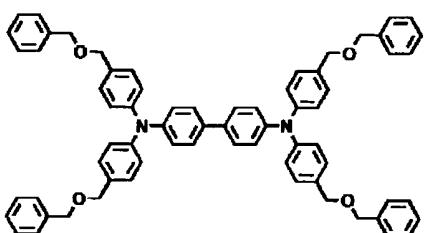
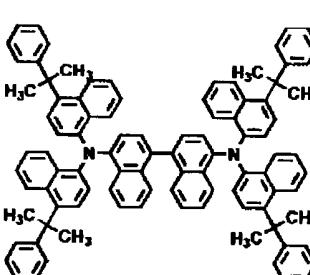
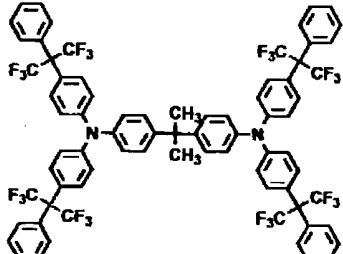
【0052】

化合物	化学構造
(22)	
(23)	
(24)	

【0053】

化合物	化 学 構 造
(25)	
(26)	
(27)	

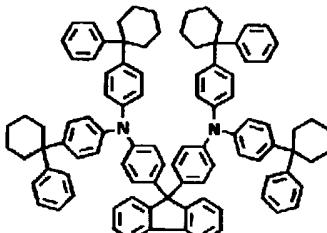
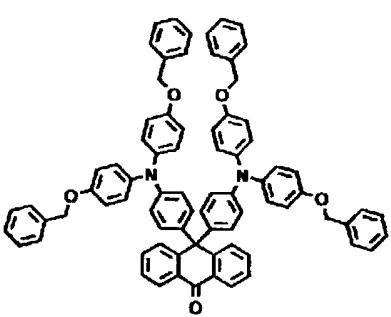
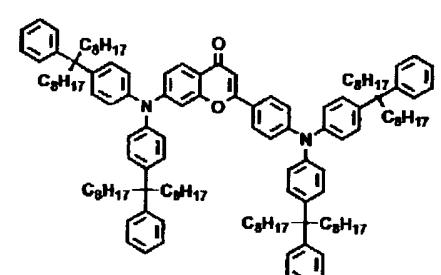
【0054】

化合物	化 学 構 造
(28)	
(29)	
(30)	

【0055】

化合物	化 学 構 造
(31)	
(32)	
(33)	

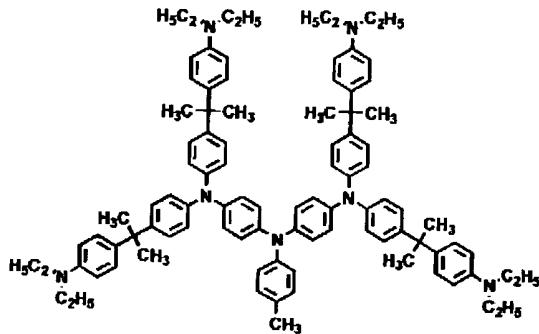
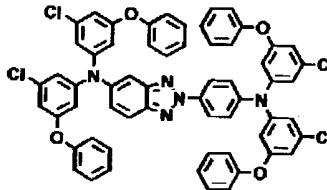
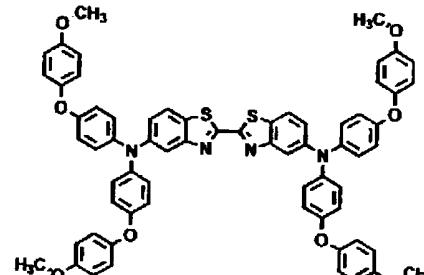
【0056】

化合物	化 学 構 造
(34)	
(35)	
(36)	

【0057】

化合物	化 学 構 造
(37)	
(38)	
(39)	

【0058】

化合物	化 学 構 造
(40)	
(41)	
(42)	

【0059】

化合物	化 学 構 造
(43)	
(44)	
(45)	

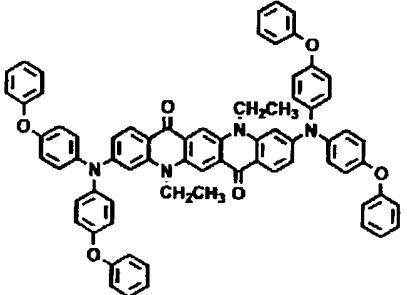
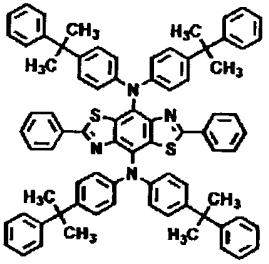
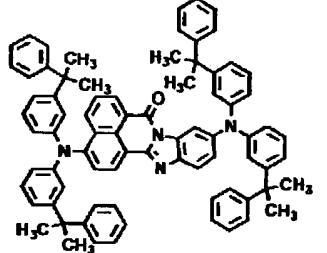
【0060】

化合物	化 学 構 造
(46)	
(47)	
(48)	

【0061】

化合物	化 学 構 造
(49)	
(50)	
(51)	

【0062】

化合物	化 学 構 造
(52)	
(53)	
(54)	

【0063】

化合物	化 学 構 造
(55)	
(56)	
(57)	

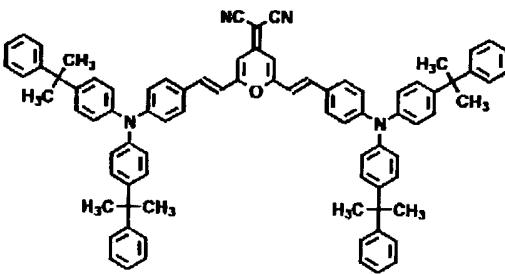
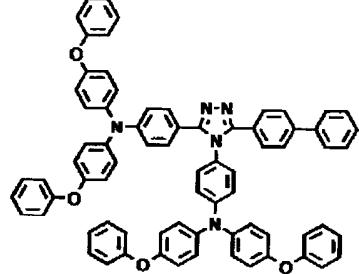
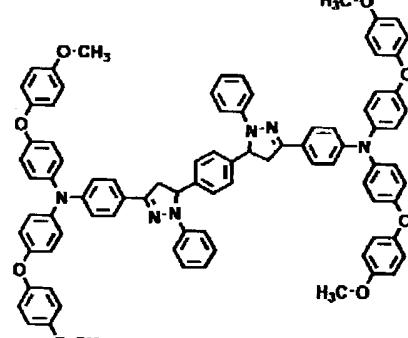
【0064】

化合物	化 学 構 造
(58)	
(59)	
(60)	

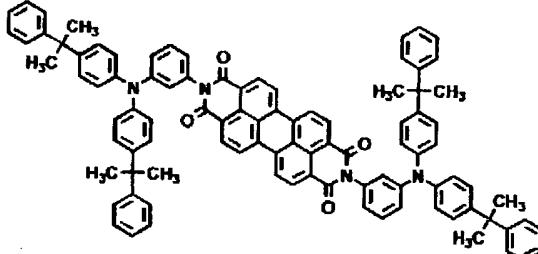
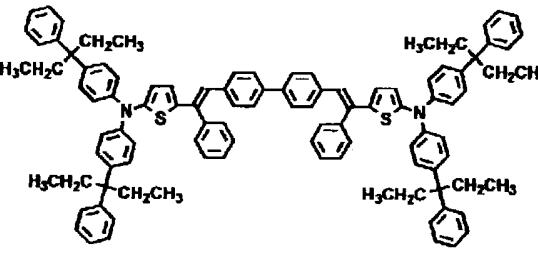
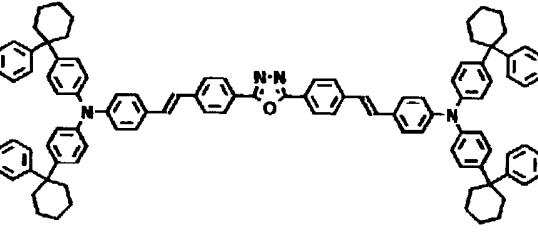
【0065】

化合物	化 学 構 造
(61)	
(62)	
(63)	

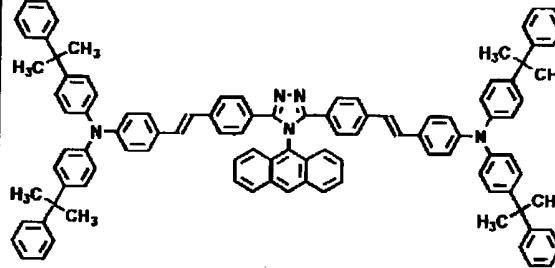
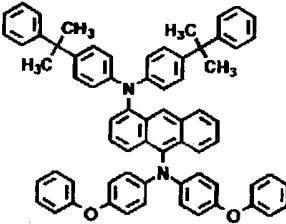
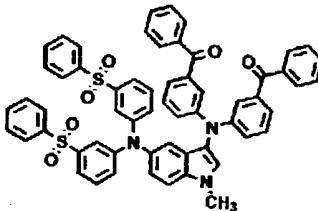
【0066】

化合物	化 学 構 造
(64)	
(65)	
(66)	

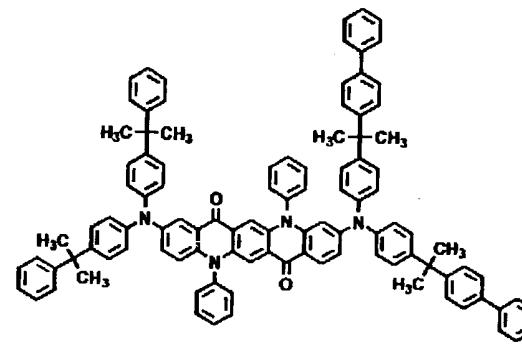
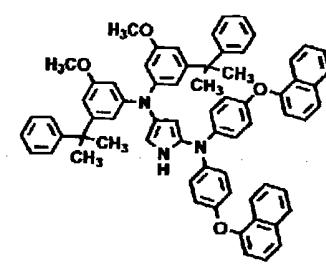
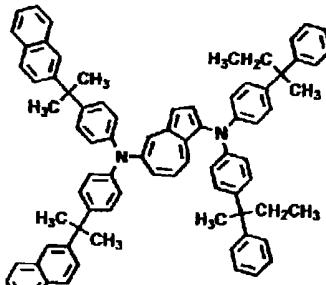
【0067】

化合物	化学構造
(67)	
(68)	
(69)	

【0068】

化合物	化 学 构 造
(70)	
(71)	
(72)	

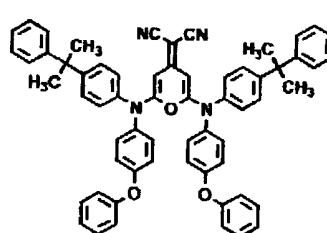
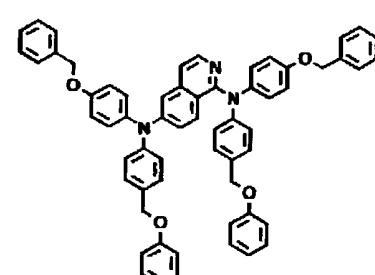
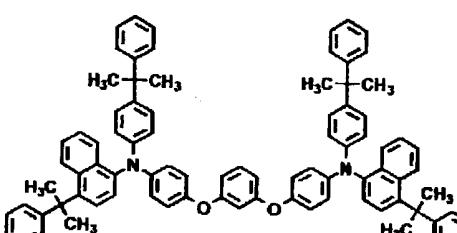
【0069】

化合物	化 学 構 造
(73)	
(74)	
(75)	

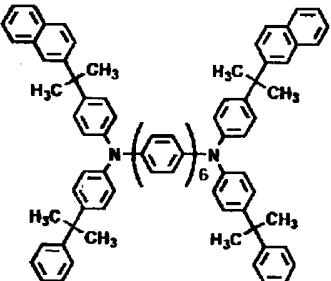
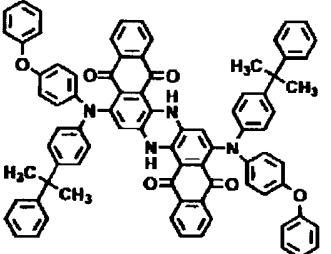
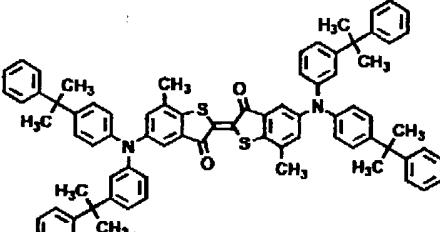
【0070】

化合物	化 学 構 造
(76)	
(77)	
(78)	

【0071】

化合物	化学構造
(79)	
(80)	
(81)	

【0072】

化合物	化学構造
(82)	
(83)	
(84)	

【0073】本発明の発光材料である化合物は、固体状態において強い蛍光を持つ化合物であり電場発光性にも優れている。また、金属電極からの優れた正孔注入性および正孔輸送性、金属電極からの優れた電子注入性および電子輸送性を併せて持ち合わせているので、発光材料として有効に使用することができ、更には、他の正孔輸送性材料、電子輸送性材料もしくはドーピング材料を使用してもさしつかえない。

【0074】有機EL素子は、陽極と陰極間に一層もしくは多層の有機薄膜を形成した素子である。一層型の場合、陽極と陰極との間に発光層を設けている。発光層は、発光材料を含有し、それに加えて陽極から注入した正孔、もしくは陰極から注入した電子を発光材料まで輸送させるために、正孔注入材料もしくは電子注入材料を含有しても良い。しかしながら、本発明の発光材料は、極めて高い発光量子効率、高い正孔輸送能力および電子輸送能力を併せ持ち、均一な薄膜を形成することができ\*50

\* るので、本発明の発光材料のみで発光層を形成することも可能である。多層型は、(陽極/正孔注入帯域/発光層/陰極)、(陽極/発光層/電子注入帯域/陰極)、(陽極/正孔注入帯域/発光層/電子注入帯域/陰極)の多層構成で積層した有機EL素子がある。本発明の発光材料である化合物は、高い発光特性を持ち、正孔注入性、正孔輸送特性および電子注入性、電子輸送特性をもっているので、発光材料として発光層に使用できる。

【0075】発光層には、必要があれば、本発明の発光材料である化合物に加えて、さらなる公知の発光材料、ドーピング材料、正孔注入材料や電子注入材料を使用することもできる。有機EL素子は、多層構造により、クエンチングによる輝度や寿命の低下を防ぐことができる。必要があれば、発光材料、ドーピング材料、正孔注入材料や電子注入材料を組み合わせて使用することが出来る。また、ドーピング材料により、発光輝度や発光効率の向上、赤色や青色の発光を得ることもで

きる。また、正孔注入帯域、発光層、電子注入帯域は、それぞれ二層以上の層構成により形成されても良い。その際には、正孔注入帯域の場合、電極から正孔を注入する層を正孔注入層、正孔注入層から正孔を受け取り発光層まで正孔を輸送する層を正孔輸送層と呼ぶ。同様に、電子注入帯域の場合、電極から電子を注入する層を電子注入層、電子注入層から電子を受け取り発光層まで電子を輸送する層を電子輸送層と呼ぶ。これらの各層は、材料のエネルギー準位、耐熱性、有機層もしくは金属電極との密着性等の各要因により選択されて使用される。

【0076】本発明の発光材料と共に発光層に使用できる発光材料またはドーピング材料としては、アントラゼン、ナフタレン、フェナントレン、ビレン、テトラゼン、コロネン、クリセン、フルオレセイン、ペリレン、フタロペリレン、ナフタロペリレン、ペリノン、フタロペリノン、ナフタロペリノン、ジフェニルブタジエン、テトラフェニルブタジエン、クマリン、オキサジアゾール、アルダジン、ビスベンゾキサゾリン、ビススチリル、ピラジン、シクロペンタジエン、キノリン金属錯体、アミノキノリン金属錯体、ベンゾキノリン金属錯体、イミン、ジフェニルエチレン、ビニルアントラゼン、ジアミノカルバゾール、ピラン、チオピラン、ボリメチン、メロシアニン、イミダゾールキレート化オキシノイド化合物、キナクリドン、ルブレンおよび色素レーザー用や増白用の蛍光色素等があるが、これらに限定されるものではない。

【0077】本発明の発光材料と共に発光層に使用できる上記の化合物の発光層中の存在比率はどれが主成分であってもよい。つまり、上記の化合物および本発明における化合物のそれぞれの組み合わせにより、本発明における化合物は発光層を形成する主材料にも他の主材料中へのドーピング材料にも成り得る。

【0078】正孔注入材料としては、正孔を輸送する能力を持ち、陽極からの正孔注入効果、発光層または発光材料に対して優れた正孔注入効果を有し、発光層で生成した励起子の電子注入帯域または電子注入材料への移動を防止し、かつ薄膜形成能力の優れた化合物が挙げられる。具体的には、フタロシアニン誘導体、ナフタロシアニン誘導体、ポルフィリン誘導体、オキサゾール、オキサジアゾール、トリアゾール、イミダゾール、イミダゾロン、イミダゾールチオン、ピラゾリン、ピラゾロン、テトラヒドロイミダゾール、オキサゾール、オキサジアゾール、ヒドロゾン、アシルヒドロゾン、ポリアリールアルカン、スチルベン、ブタジエン、ベンジジン型トリフェニルアミン、スチリルアミン型トリフェニルアミン、ジアミン型トリフェニルアミン等と、それらの誘導体、およびポリビニルカルバゾール、ポリシラン、導電性高分子等の高分子材料等があるが、これらに限定されるものではない。

【0079】本発明の有機EL素子において使用できる

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正孔注入材料の中で、さらに効果的な正孔注入材料は、芳香族三級アミン誘導体もしくはフタロシアニン誘導体である。芳香族三級アミン誘導体の具体例としては、トリフェニルアミン、トリトリルアミン、トリルジフェニルアミン、N, N', N''-ジフェニル-N, N', N''-ジ(3-メチルフェニル)-1, 1'-ビフェニル-4, 4'-ジアミン、N, N, N', N''-テトラ(4-メチルフェニル)-1, 1'-フェニル-4, 4'-ジアミン、N, N, N', N''-テトラ(4-メチルフェニル)-1, 1'-ビフェニル-4, 4'-ジアミン、N, N'-ジフェニル-N, N'-ジ(1-ナフチル)-1, 1'-ビフェニル-4, 4'-ジアミン、N, N'-ジ(メチルフェニル)-N, N'-ジ(4-n-ブチルフェニル)フェナントレン-9, 10-ジアミン、4, 4', 4''-トリス(N-(3-メチルフェニル)-N-フェニルアミノ)トリフェニルアミン、1, 1-ビス(4-ジ-p-トリルアミノフェニル)シクロヘキサン等、もしくはこれらの芳香族三級アミン骨格を有したオリゴマーもしくはポリマー等があるが、これらに限定されるものではない。

【0080】フタロシアニン(Pc)誘導体の具体例としては、H<sub>2</sub>Pc、CuPc、CoPc、NiPc、ZnPc、PdPc、FePc、MnPc、ClAlPc、ClGaPc、ClInPc、ClSnPc、Cl<sub>2</sub>SiPc、(HO)AlPc、(HO)GaPc、VO<sub>2</sub>Pc、TiOPc、MoOPc、GaPc-O-GaPc等のフタロシアニン誘導体およびナフタロシアニン誘導体等があるが、これらに限定されるものではない。

【0081】電子注入材料としては、電子を輸送する能力を持ち、陰極からの正孔注入効果、発光層または発光材料に対して優れた電子注入効果を有し、発光層で生成した励起子の正孔注入帯域への移動を防止し、かつ薄膜形成能力の優れた化合物が挙げられる。例えば、フルオレノン、アントラキノジメタン、ジフェノキノン、チオピランジオキシド、オキサゾール、オキサジアゾール、トリアゾール、イミダゾール、ペリレンテトラカルボン酸、フレオレニリデンメタン、アントラキノジメタン、アントロン等とそれらの誘導体があるが、これらに限定されるものではない。また、正孔注入材料に電子受容物質を、電子注入材料に電子供与性物質を添加することにより増感させることもできる。

【0082】本発明の有機EL素子において、さらに効果的な電子注入材料は、金属錯体化合物もしくは含窒素五員環誘導体である。具体的には、金属錯体化合物としては、8-ヒドロキシキノリナートリチウム、ビス(8-ヒドロキシキノリナート)亜鉛、ビス(8-ヒドロキシキノリナート)銅、ビス(8-ヒドロキシキノリナート)マンガン、トリス(8-ヒドロキシキノリナート)アルミニウム、トリス(2-メチル-8-ヒドロキシキノリナート)アルミニウム、トリス(8-ヒドロキシ

ノリナート)ガリウム、ビス(10-ヒドロキシベンゾ[*h*]キノリナート)ベリリウム、ビス(10-ヒドロキシベンゾ[*h*]キノリナート)亜鉛、ビス(2-メチル-8-キノリナート)クロロガリウム、ビス(2-メチル-8-キノリナート)(o-クレゾラート)ガリウム、ビス(2-メチル-8-キノリナート)(1-ナフトラート)アルミニウム、ビス(2-メチル-8-キノリナート)(2-ナフトラート)ガリウム、ビス(2-メチル-8-キノリナート)フェノラートガリウム、ビス(o-(2-ベンゾオキサゾリル)フェノラート)亜鉛、ビス(o-(2-ベンゾチアゾリル)フェノラート)亜鉛、ビス(o-(2-ベンゾトリアゾリル)フェノラート)亜鉛等があるが、これらに限定されるものではない。また、含窒素五員誘導体としては、オキサゾール、チアゾール、オキサジアゾール、チアジアゾールもしくはトリアゾール誘導体が好ましい。具体的には、2, 5-ビス(1-フェニル)-1, 3, 4-オキサゾール、1, 4-ビス(2-(4-メチル-5-フェニルオキサゾリル))ベンゼン、2, 5-ビス(1-フェニル)-1, 3, 4-チアゾール、2, 5-ビス(1-フェニル)-1, 3, 4-オキサジアゾール、2-(4'-tert-ブチルフェニル)-5-(4"-ビフェニル)1, 3, 4-オキサジアゾール、2, 5-ビス(1-ナフチル)-1, 3, 4-オキサジアゾール、1, 4-ビス[2-(5-フェニルオキサジアゾリル)]ベンゼン、1, 4-ビス[2-(5-フェニルオキサジアゾリル)-4-tert-ブチルベンゼン]、2-(4'-tert-ブチルフェニル)-5-(4"-ビフェニル)-1, 3, 4-チアジアゾール、2, 5-ビス(1-ナフチル)-1, 3, 4-チアジアゾール、1, 4-ビス[2-(5-フェニルチアジアゾリル)]ベンゼン、2-(4'-tert-ブチルフェニル)-5-(4"-ビフェニル)-1, 3, 4-トリアゾール、2, 5-ビス(1-ナフチル)-1, 3, 4-トリアゾール、1, 4-ビス[2-(5-フェニルトリアゾリル)]ベンゼン等があるが、これらに限定されるものではない。

【0083】本有機EL素子においては、発光層中に、本発明の発光材料の他に、他の発光材料、ドーピング材料、正孔注入材料および電子注入材料の少なくとも1種が同一層に含有されてもよい。また、本発明により得られた有機EL素子の、温度、湿度、雰囲気等に対する安定性の向上のために、素子の表面に保護層を設けたり、シリコンオイル、樹脂等により素子全体を保護することも可能である。

【0084】有機EL素子の陽極に使用される導電性材料としては、4 eVより大きな仕事関数を持つものが適しており、炭素、アルミニウム、バナジウム、鉄、コバルト、ニッケル、タンクステン、銀、金、白金、パラジウム等およびそれらの合金、ITO基板、NEA基板

に使用される酸化スズ、酸化インジウム等の酸化金属、さらにはポリチオフェンやポリピロール等の有機導電性樹脂が用いられる。

【0085】陰極に使用される導電性物質としては、4 eVより小さな仕事関数を持つものが適しており、マグネシウム、カルシウム、錫、鉛、チタニウム、イットリウム、リチウム、ルテニウム、マンガン、アルミニウム等およびそれらの合金が用いられるが、これらに限定されるものではない。合金としては、マグネシウム/銀、マグネシウム/インジウム、リチウム/アルミニウム等が代表例として挙げられるが、これらに限定されるものではない。合金の比率は、蒸着源の温度、雰囲気、真空度等により制御され、適切な比率に選択される。陽極および陰極は、必要があれば二層以上の層構成により形成されていても良い。

【0086】有機EL素子では、効率良く発光させるために、少なくとも一方は素子の発光波長領域において充分透明にすることが望ましい。また、基板も透明であることが望ましい。透明電極は、上記の導電性材料を使用して、蒸着やスパッタリング等の方法で所定の透光性が確保するように設定する。発光面の電極は、光透過率を10%以上にすることが望ましい。基板は、機械的、熱的強度を有し、透明性を有するものであれば限定されるものではないが、例示すると、ガラス基板、ポリエチレン板、ポリエチレンテレフート板、ポリエーテルサルファン板、ポリプロピレン板等の透明樹脂があげられる。

【0087】本発明に係わる有機EL素子の各層の形成は、真空蒸着、スパッタリング、プラズマ、イオンプレーティング等の乾式成膜法やスピンドルコーティング、ディッピング、フローコーティング等の湿式成膜法のいずれの方法を適用することができる。膜厚は特に限定されるものではないが、適切な膜厚に設定する必要がある。膜厚が厚すぎると、一定の光出力を得るために大きな印加電圧が必要になり効率が悪くなる。膜厚が薄すぎるとピンホール等が発生して、電界を印加しても充分な発光輝度が得られない。通常の膜厚は5 nmから10 μmの範囲が適しているが、10 nmから0.2 μmの範囲がさらに好ましい。

【0088】湿式成膜法の場合、各層を形成する材料を、エタノール、クロロホルム、テトラヒドロフラン、ジオキサン等の適切な溶媒に溶解または分散させて薄膜を形成するが、その溶媒はいずれであっても良い。また、いずれの有機薄膜層においても、成膜性向上、膜のピンホール防止等のため適切な樹脂や添加剤を使用しても良い。使用の可能な樹脂としては、ポリスチレン、ポリカーボネート、ポリアリレート、ポリエステル、ポリアミド、ポリウレタン、ポリスルファン、ポリメチルメタクリレート、ポリメチルアクリレート、セルロース等の絶縁性樹脂およびそれらの共重合体、ポリ-N-ビニ

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ルカルバゾール、ポリシラン等の光導電性樹脂、ポリチオフェン、ポリビロール等の導電性樹脂を挙げることができる。また、添加剤としては、酸化防止剤、紫外線吸収剤、可塑剤等を挙げることができる。

【0089】以上のように、有機EL素子の発光層に本発明の化合物を用いることにより、発光効率、最大発光輝度等の有機EL素子特性を改良することができた。また、この素子は熱や電流に対して非常に安定であり、さらには低い駆動電圧で実用的に使用可能の発光輝度が得られるため、従来まで大きな問題であった劣化も大幅に低下させることができた。

【0090】本発明の有機EL素子は、壁掛けテレビ等のフラットパネルディスプレイや、平面発光体として、複写機やプリンター等の光源、液晶ディスプレイや計器類等の光源、表示板、標識灯等へ応用が考えられ、その工業的価値は非常に大きい。

【0091】本発明の材料は、有機EL素子、電子写真感光体、光電変換素子、太陽電池、イメージセンサー等の分野においても使用できる。

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【実施例】以下、本発明を実施例に基づきさらに詳細に説明する。

## 実施例1

洗浄したITO電極付きガラス板上に、発光材料として表3の化合物(1)、2, 5-ビス(1-ナフチル)-1, 3, 4-オキサジアゾール、ポリカーボネート樹脂(帝人化成:パンライトK-1300)を5:3:2の重量比でテトラヒドロフランに溶解させ、スピンドル法により膜厚100nmの発光層を得た。その上に、マグネシウムとインジウムを10:1で混合した合金で膜厚150nmの電極を形成して有機EL素子を得た。この素子の発光特性は、直流電圧5Vで90(c d/m<sup>2</sup>)、最高輝度1500(c d/m<sup>2</sup>)、発光効率0.50(1m/W)の青色発光が得られた。

## 【0093】実施例2

洗浄したITO電極付きガラス板上に、表3の化合物(2)を真空蒸着して膜厚100nmの発光層を作成し、その上に、マグネシウムと銀を10:1で混合した合金で膜厚100nmの電極を形成して有機EL素子を得た。発光層は10<sup>-6</sup>Torrの真空中で、基板温度室温の条件下で蒸着した。この素子は、直流電圧5Vで260(c d/m<sup>2</sup>)、最高輝度800(c d/m<sup>2</sup>)、

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発光効率0.60(1m/W)の緑色発光が得られた。

## 【0094】実施例3

洗浄したITO電極付きガラス板上に、表3の化合物(3)を塩化メチレンに溶解させ、スピンドル法により膜厚50nmの発光層を得た。次いで、ビス(2-メチル-8-キノリナート)(2-ナフトラート)アルミニウムを真空蒸着して膜厚10nmの電子注入層を作成し、その上に、マグネシウムとアルミニウムを10:1で混合した合金で膜厚100nmの電極を形成して有機EL素子を得た。発光層および電子注入層は10<sup>-6</sup>Torrの真空中で、基板温度室温の条件下で蒸着した。この素子は、直流電圧5Vで200(c d/m<sup>2</sup>)、最高輝度12000(c d/m<sup>2</sup>)、発光効率1.2(1m/W)の青緑色発光が得られた。

## 【0095】実施例4

洗浄したITO電極付きガラス板上に、表3の化合物(2)を真空蒸着して、膜厚50nmに発光層を形成した。次いで、トリス(8-ヒドロキシキノリナート)アルミニウムを真空蒸着して膜厚10nmの電子注入層を作成し、その上に、アルミニウムトリチウムを50:1で混合した合金で膜厚100nmの電極を形成して有機EL素子を得た。正孔注入層および発光層は10<sup>-6</sup>Torrの真空中で、基板温度室温の条件下で蒸着した。この素子は、直流電圧5Vで約150(c d/m<sup>2</sup>)、最高輝度9000(c d/m<sup>2</sup>)、発光効率1.1(1m/W)の緑色発光が得られた。

## 【0096】実施例5~83

洗浄したITO電極付きガラス板上に表4の正孔注入材料のうちの1種を真空蒸着して、膜厚30nmの正孔注入層を得た。次いで、表3の発光材料のうちの1種を真空蒸着して膜厚30nmの発光層を得た。さらに、表4の電子注入材料のうちの1種を真空蒸着して膜厚30nmの電子注入層を作成し、その上に、マグネシウムと銀を10:1で混合した合金で膜厚150nmの膜厚の電極を形成して有機EL素子を得た。各層は10<sup>-6</sup>Torrの真空中で、基板温度室温の条件下で蒸着した。各素子に使用した材料とこの素子の発光特性を表5に示す。本実施例の有機EL素子は、全て最高輝度5000(c d/m<sup>2</sup>)以上の高輝度特性を有していた。

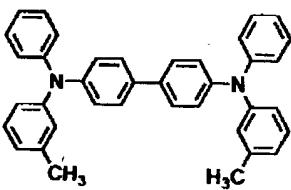
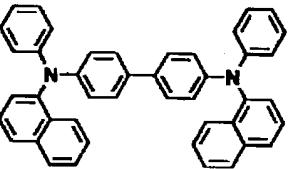
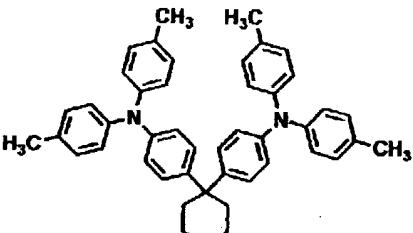
## 【0097】

## 【表4】

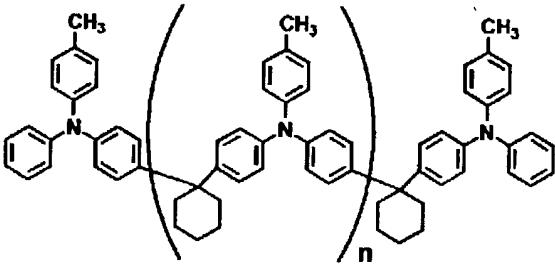
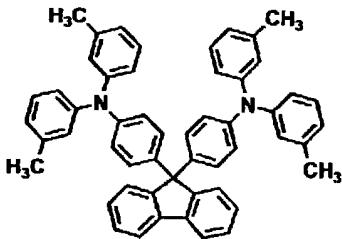
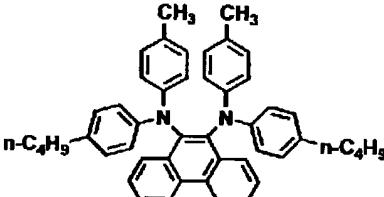
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化合物	化 学 構 造
(H-1)	
(H-2)	
(H-3)	

【0098】

化合物	化学構造
(H-4)	 <p style="text-align: center;"><math>n = 2 \sim 6</math></p>
(H-5)	
(H-6)	

【0099】

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化合物	化 学 構 造	化合物	化 学 構 造
(E-1)		(E-4)	
(E-2)		(E-5)	
(E-3)		(E-6)	

【0100】

\* \* 【表5】

実施例	正孔注入材料 (表4)	発光材料 (表3)	電子注入材料 (表4)	発光輝度 (cd/m <sup>2</sup> )	最大発光輝度 (cd/m <sup>2</sup> )	最大発光効率 (lm/W)
5	(H-1)	(6)	(E-2)	280	29800	2.2
6	(H-2)	(7)	(E-3)	550	24300	3.9
7	(H-3)	(8)	(E-1)	230	27500	2.7
8	(H-4)	(9)	(E-5)	540	21200	3.3
9	(H-5)	(10)	(E-6)	370	12600	1.4
10	(H-6)	(11)	(E-4)	420	49000	2.5
11	(H-3)	(12)	(E-2)	360	45700	4.6
12	(H-4)	(13)	(E-3)	330	38500	4.8
13	(H-1)	(14)	(E-5)	460	31900	2.7
14	(H-5)	(15)	(E-4)	390	30300	3.2
15	(H-4)	(16)	(E-5)	310	15600	2.8
16	(H-6)	(17)	(E-5)	780	7000	1.8
17	(H-3)	(18)	(E-6)	710	26800	2.2
18	(H-2)	(19)	(E-5)	350	9200	2.3
19	(H-6)	(20)	(E-2)	600	40400	4.4
20	(H-3)	(21)	(E-2)	560	17400	3.5
21	(H-6)	(22)	(E-4)	400	9200	1.9
22	(H-1)	(23)	(E-1)	310	34900	3.1
23	(H-6)	(24)	(E-2)	720	50300	5.7
24	(H-5)	(25)	(E-1)	400	40300	5.4
25	(H-5)	(26)	(E-5)	550	54200	4.6
26	(H-2)	(27)	(E-6)	780	28300	2.9
27	(H-3)	(28)	(E-6)	300	25000	2.4
28	(H-4)	(29)	(E-6)	230	50600	4.7
29	(H-4)	(30)	(E-5)	380	41500	4.1
30	(H-4)	(31)	(E-4)	330	47500	3.3
31	(H-1)	(32)	(E-5)	790	17800	2.3
32	(H-4)	(33)	(E-4)	350	6600	1.6
33	(H-6)	(34)	(E-5)	330	33300	3.5
34	(H-4)	(35)	(E-3)	600	39900	3.5
35	(H-6)	(36)	(E-2)	540	31100	3.6
36	(H-5)	(37)	(E-6)	560	25900	2.4
37	(H-6)	(38)	(E-5)	680	28500	2.7
38	(H-1)	(39)	(E-6)	500	43400	2.7
39	(H-5)	(40)	(E-3)	730	24900	2.3
40	(H-1)	(41)	(E-2)	320	19600	2.6
41	(H-6)	(42)	(E-4)	770	45200	4.7
42	(H-5)	(43)	(E-5)	400	35100	2.9
43	(H-2)	(44)	(E-1)	730	26100	2.2

発光輝度は直流5V印加時の値

【0101】

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実施例	正孔注入材料 (表4)	発光材料 (表3)	電子注入材料 (表4)	発光輝度 (cd/m <sup>2</sup> )	最大発光輝度 (cd/m <sup>2</sup> )	最大発光効率 (lm/W)
44	(H-1)	(45)	(E-4)	550	41800	4.8
45	(H-2)	(46)	(E-4)	440	29900	2.9
46	(H-3)	(47)	(E-4)	290	9700	1.8
47	(H-6)	(48)	(E-4)	270	8100	2.4
48	(H-5)	(49)	(E-6)	690	15000	1.0
49	(H-2)	(50)	(E-5)	330	48600	5.1
50	(H-3)	(51)	(E-6)	490	57300	6.1
51	(H-6)	(52)	(E-5)	280	52800	5.6
52	(H-2)	(53)	(E-2)	290	41000	5.4
53	(H-5)	(54)	(E-3)	790	30900	2.5
54	(H-3)	(55)	(E-4)	440	47800	3.9
55	(H-3)	(56)	(E-6)	280	47600	4.6
56	(H-4)	(57)	(E-2)	760	15600	1.4
57	(H-1)	(58)	(E-2)	700	19000	1.7
58	(H-4)	(59)	(E-6)	660	14600	1.8
59	(H-3)	(60)	(E-4)	420	31700	3.7
60	(H-3)	(61)	(E-5)	560	48900	4.3
61	(H-2)	(62)	(E-6)	600	44800	5.2
62	(H-4)	(63)	(E-4)	240	39200	3.7
63	(H-5)	(64)	(E-2)	330	20700	1.6
64	(H-6)	(65)	(E-1)	690	7600	1.9
65	(H-6)	(66)	(E-3)	390	9800	1.6
66	(H-5)	(67)	(E-1)	770	9200	1.7
67	(H-4)	(68)	(E-5)	660	9200	1.3
68	(H-2)	(69)	(E-6)	700	21000	2.7
69	(H-4)	(70)	(E-4)	210	34100	4.6
70	(H-2)	(71)	(E-3)	630	47300	4.4
71	(H-6)	(72)	(E-3)	660	29300	3.5
72	(H-5)	(73)	(E-4)	510	41400	5.1
73	(H-1)	(74)	(E-2)	690	18400	1.4
74	(H-5)	(75)	(E-3)	370	8200	1.9
75	(H-4)	(76)	(E-2)	570	22500	1.6
76	(H-1)	(77)	(E-4)	720	39500	4.2
77	(H-5)	(78)	(E-5)	710	10300	1.6
78	(H-2)	(79)	(E-6)	780	8900	1.2
79	(H-5)	(80)	(E-3)	250	21000	2.5
80	(H-4)	(81)	(E-6)	320	20500	1.8
81	(H-2)	(82)	(E-2)	310	30200	3.7
82	(H-4)	(83)	(E-1)	230	36600	3.9
83	(H-1)	(84)	(E-1)	580	35900	3.4

## 【0102】実施例84

洗浄したITO電極付きガラス板上に、4, 4', 4"-トリス(N-(3-メチルフェニル)-N-フェニルアミノ)トリフェニルアミンを真空蒸着して、膜厚25 nmの第一正孔注入層を得た。さらに、正孔注入材料(H-1)を真空蒸着して、膜厚5 nmの第二正孔注入層を得た。次いで、発光材料として化合物(2)を真空蒸着して膜厚20 nmの発光層を得た。さらに、電子注入材料(E-1)を真空蒸着して、膜厚30 nmの電子注入層を得た。その上に、マグネシウムと銀を10:1で混合した合金で膜厚150 nmの電極を形成して有機EL素子を得た。この素子は、直流電圧5 Vで710 (cd/m<sup>2</sup>)、最高輝度29000 (cd/m<sup>2</sup>)、発光効率2.7 (1 m/W) の青緑色発光が得られた。

## 【0103】実施例85

洗浄したITO電極付きガラス板上に、4, 4', 4"-トリス(N-(1-ナフチル)-N-フェニルアミノ)トリフェニルアミンを真空蒸着して、膜厚25 nmの第一正孔注入層を得た。さらに、正孔注入材料(H-2)を真空蒸着して、膜厚5 nmの第二正孔注入層を得た。次いで、発光材料として化合物(3)を真空蒸着し\*50

30\*で膜厚20 nmの発光層を得た。さらに、電子注入材料(E-5)を真空蒸着して、膜厚30 nmの電子注入層を得た。その上に、マグネシウムと銀を10:1で混合した合金で膜厚150 nmの電極を形成して有機EL素子を得た。この素子は、直流電圧5 Vで650 (cd/m<sup>2</sup>)、最高輝度35000 (cd/m<sup>2</sup>)、発光効率3.6 (1 m/W) の緑色発光が得られた。

## 【0104】実施例86

洗浄したITO電極付きガラス板上に、正孔注入材料(H-5)を真空蒸着して、膜厚20 nmの正孔注入層を得た。次いで、発光材料として化合物(4)を真空蒸着して膜厚20 nmの発光層を得た。さらに、電子注入材料(E-2)を真空蒸着して、膜厚20 nmの第一電子注入層を得た。次いで電子注入材料(E-5)を真空蒸着して、膜厚10 nmの第二電子注入層を得た。その上に、マグネシウムと銀を10:1で混合した合金で膜厚150 nmの電極を形成して有機EL素子を得た。この素子は、直流電圧5 Vで120 (cd/m<sup>2</sup>)、最高輝度15000 (cd/m<sup>2</sup>)、発光効率3.2 (1 m/W) の橙色発光が得られた。

## 【0105】実施例87~90

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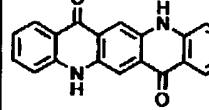
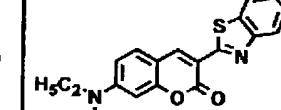
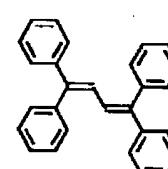
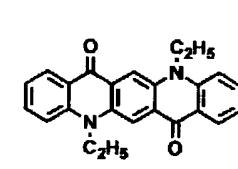
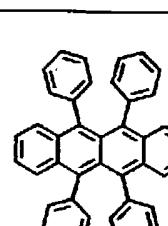
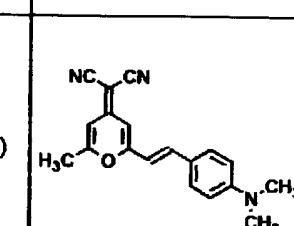
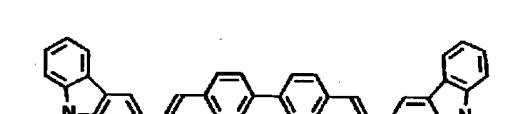
発光層として、表3の化合物(5)と表6の化合物のうちの1種を100:1の重量比で蒸着した膜厚30nmの発光層を使用する以外は、実施例5と同様の方法で有機EL素子を作製した。この素子の発光特性を表7に示す。本実施例の有機EL素子は、全て最高輝度2000\*

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\* 0 (c d / m<sup>2</sup>) 以上の高輝度特性を有し、また、目的の発光色を得ることができた。

[0106]

【表6】

化合物	化学構造	化合物	化学構造
(D-1)		(D-4)	
(D-2)		(D-5)	
(D-3)		(D-6)	
(D-7)			

### 【0107】実施例90~94

発光層として、表3の化合物(27)と表6の化合物のうちの1種を100:1の重量比で蒸着した膜厚30nmの発光層を使用する以外は、実施例5と同様の方法で有機EL素子を作製した。この素子の発光特性を表7に示す。本実施例の有機EL素子は、全て最高輝度20000(cd/m<sup>2</sup>)以上の高輝度特性を有し、また、目的の発光色を得ることができた。

### 【0108】案施例95

洗浄したITO電極付きガラス板上に、正面注入材料

(H-2) を真空蒸着して、膜厚 30 nm の正孔注入層を得た。次いで、発光層として 4, 4'-ビス(β-β

※—ジフェニルビニル) ビフェニルと表3の発光材料

(1) を 100:5 の重量比で真空蒸着して膜厚 30 nm の発光層を得た。さらに、電子注入材料 (E-3) を真空蒸着して、膜厚 30 nm の電子注入層を得た。その上に、マグネシウムと銀を 10:1 で混合した合金で膜厚 150 nm の電極を形成して有機 EL 素子を得た。この素子は、直流電圧 5 V で 480 (cd/m<sup>2</sup>) 、最高輝度 28000 (cd/m<sup>2</sup>) 、発光効率 3.1 (1 m/W) の青色発光が得られた。

### 【0109】实施例9 6~108

発光層として、トリス(8-ヒドロキシキノリナート)アルミニウムと表3の発光材料のうちの1種を100:

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3の重量比で蒸着した膜厚30nmの発光層を使用する  
以外は、実施例95と同様の方法で有機EL素子を作製  
した。この素子の発光特性を表7に示す。本実施例の有  
機EL素子は、全て最高輝度20000(cd/m<sup>2</sup>)\*

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\*以上の高輝度特性を有した。

【0110】

【表7】

実施例	化合物 (表8, 6)	発光輝度 (cd/m <sup>2</sup> )	最大発光輝度 (cd/m <sup>2</sup> )	最大発光効率 (lm/W)
87	(D-1)	720	78400	8.1
88	(D-2)	310	53700	4.5
89	(D-3)	250	39800	4.8
90	(D-4)	830	37100	3.9
91	(D-5)	260	55200	5.2
92	(D-6)	480	29200	2.3
93	(D-7)	800	37800	3.8
94	(D-3)	810	27700	2.4
98	(2)	390	58000	6.2
97	(4)	250	29600	3.4
98	(14)	220	61800	5.1
99	(15)	160	54400	3.7
100	(23)	240	46700	3.8
101	(36)	870	55200	5.9
102	(41)	560	26500	4.1
103	(54)	830	35300	3.9
104	(55)	870	59200	6.7
105	(58)	210	24500	2.1
106	(64)	640	23800	3.1
107	(67)	880	20700	1.9
108	(79)	550	25700	2.7

発光輝度は直流5V印加時の値

【0111】本実施例で示された有機EL素子は、発光輝度として5000(cd/m<sup>2</sup>)以上であり、全て高い発光効率を得ることができた。本実施例で示された有機EL素子について、3(mA/cm<sup>2</sup>)で連続発光させたところ、1000時間以上安定な発光を観測することができ、ダーツスポットもほとんど観察されなかつた。本発明の有機EL素子材料を発光材料として使用した有機EL素子は、発光材料の蛍光量子効率が極めて高いので、この発光材料を使用した素子においては、低電流印可領域での高輝度発光が可能になり、また、発光層中で一般式[1]、一般式[4]または一般式[5]の化合物に加えてドーピング材料を使用することにより、最大発光輝度、最大発光効率を向上させることができた。さらには、本発明の発光材料である化合物に、蛍光色の異なるドーピング材料を添加することによって、異※

※なる発光色の発光素子を得ることができた。

【0112】本発明の有機EL素子は発光効率、発光輝度の向上と長寿命化を達成するものであり、併せて使用される発光材料、ドーピング材料、正孔注入材料、電子注入材料、増感剤、樹脂、電極材料等および素子作製方法を限定するものではない。

【発明の効果】本発明の有機EL素子材料を発光材料として使用した有機EL素子は、従来に比べて高い発光効率で高輝度の発光を示し、長寿命の有機EL素子を得ることができた。以上により本発明で示した化合物を、有機EL素子の少なくとも一層に使用すること、および、本発明の素子構成により形成された有機EL素子は、高輝度、高発光効率、長寿命の有機EL素子を容易に作製することが可能となった。

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フロントページの続き

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ンキ製造株式会社内

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JPPO machine translation  
for JP 10-251633

1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the luminescent material for the organic (electroluminescence EL) components and the light emitting device of high brightness which are used for the flat-surface light source or a display.

[0002]

[Description of the Prior Art] Promising \*\* of the application as a large area full color display device with a cheap solid-state luminescence mold is carried out, and, as for the EL element which used the organic substance, many development is performed. Generally EL consists of counterelectrodes of the pair the luminous layer and this whose layer were pinched. When electric field are impressed between two electrodes, an electron is poured in from a cathode side and, as for luminescence, an electron hole is poured in from an anode plate side. Furthermore, in case this electron recombines with an electron hole in a luminous layer and an energy level returns from a conduction band to a valence band, it is the phenomenon which emits energy as a light.

[0003] Compared with the inorganic EL element, the conventional organic EL device had high driver voltage, and luminescence brightness and its luminous efficiency were also low. Moreover, property degradation is also remarkable and it had not resulted in utilization. In recent years, the organic EL device which carried out the laminating of the thin film containing an organic compound with the high fluorescence quantum efficiency which emits light by the low battery not more than 10V is reported, and the interest is attracted (refer to applied FIJIKUSU Letters, 51 volumes, 913 pages, and 1987). This approach used the luminous layer and the amine system compound for the hole-injection layer for the metal chelate complex, green luminescence of high brightness has been obtained, several 1000 cds/m<sup>2</sup>, and the maximum luminous efficiency attain 1.5 lm/W with the direct current voltage of 6-7V, and brightness has the engine performance near a practical use field.

[0004] However, although luminescence reinforcement is improved for the organic EL device to current by the improvement of a configuration, it does not have still sufficient luminescence brightness. Moreover, it has the big problem of being inferior to the stability at the time of repeat use. This had chemically unstable metal chelate complexes, such as for example, a tris(8-hydroxyquinolinate)aluminium complex, at the time of electroluminescence, that of adhesion with cathode was bad, and had deteriorated greatly in short-time luminescence. Development of the luminescent material which has the luminescence capacity which was excellent for development of the organic EL device which had high luminescence brightness and luminous efficiency and was excellent in the stability in the time of repeat use, and is durable for the above reason is desired.

[0005]

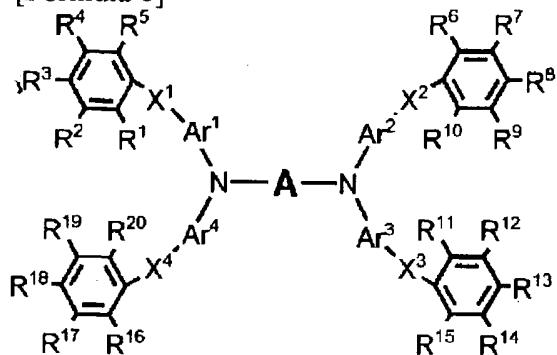
[Problem(s) to be Solved by the Invention] Luminescence brightness of this invention is high and it is in offer of the organic EL device which was excellent in the stability in the time of repeat use. As a result of this invention persons' inquiring wholeheartedly, the luminescence brightness and luminous efficiency of an organic EL device which used the luminescent material for organic EL devices shown by either the general formula [1], the general formula [4] or the general formula [5] for the luminous layer are high, and it finds out that the stability in the time of repeat use is also excellent, and came to accomplish this invention.

[0006]

[Means for Solving the Problem] This invention relates to the luminescent material for organic electroluminescent elements shown by the following general formula [1].

General formula [1]

[0007]  
[Formula 6]

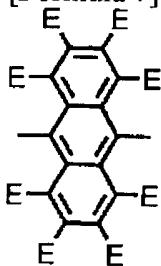


[0008] A among [type The fused aromatic ring radical which is not permuted [ the ring radical which is not permuted / a permutation or /, a permutation, or ] The complex ring radical which is not permuted [ (however, the following general formula [2] is removed) a permutation, or ], The condensation complex ring radicals which are not permuted [ a permutation or ], those congeners, or two or more sorts of different ring structure units A 2-10-piece direct or oxygen atom, The divalent radical connected through at least one of the chain structure unit which may also contain a hetero atom, and a non-ring structural unit with a nitrogen atom, a sulfur atom, and 1-20 carbon numbers is expressed (however, the case where it is the following general formula [3] is removed.). . Ar1 -Ar4 The fused aromatic ring radical which is not permuted [ the ring radical which is not permuted / a permutation or /, a permutation, or ] is expressed independently, respectively. X1 - X4 respectively -- independent -O-, -S-, >C=O, and >SO2 -- Express the divalent aliphatic series ring machine which is not permuted [ the alkylene group of the carbon numbers 2-20 which are not permuted / the alkylidene radical of the carbon numbers 2-20 which are not permuted / Cx H2x-O-(CyH2y)-, a permutation, or /, a permutation, or /, a permutation, or ] (here, although the integer of 0-20 is expressed, respectively, x and y). it is not set to x+y=0. Independently R1 -R20, respectively The alkyl group which is not permuted [ a hydrogen atom, a halogen atom, a permutation, or ], The ring radical which is not permuted [ the alkoxy group which is not permuted / a permutation or /, a permutation, or ], The amino group which is not permuted [ the complex ring radical which is not permuted / a permutation or /, a permutation, or ] is expressed (it may join together by the adjoining substituents and R1 -R5, R6 -R10, R11-R15, or R16-R20 may form a new ring.). . ]

General formula [2]

[0009]

[Formula 7]

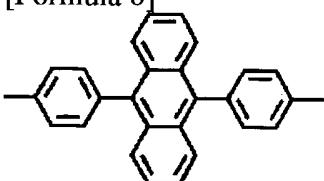


[0010] (It may join together by E which a hydrogen atom or arbitration adjoined, and E may form new 6 member aromatic series ring.)

General formula [3]

[0011]

[Formula 8]

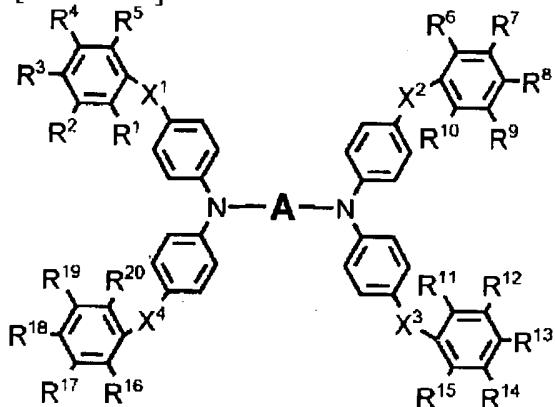


[0012] Furthermore, this invention relates to the above-mentioned luminescent material for organic electroluminescent elements shown by the following general formula [4].

General formula [4]

[0013]

[Formula 9]



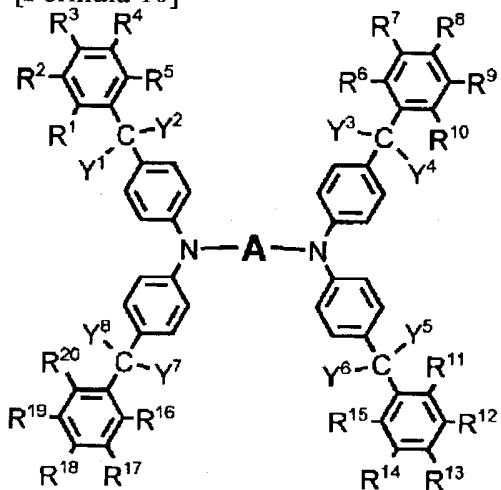
[0014] [-- A, X1 -X4, and R1 -R20 express among a formula the same semantics as what was defined above, respectively.]

[0015] Furthermore, this invention relates to the above-mentioned luminescent material for organic electroluminescent elements shown by the following general formula [5].

General formula [5]

[0016]

[Formula 10]



[0017] A and R1 -R20 express among [type the same semantics as what was defined above, respectively. Y1 -Y8 The aromatic series ring machine of the carbon numbers 6-16 which are not permuted [ the alkyl group of the carbon numbers 1-20 which are not permuted / a permutation or /, a permutation, or ] is expressed (it is Y1, Y2, Y3 and Y4, Y5 and Y6, and Y7 and Y8, and the aliphatic series ring machine of the carbon numbers 5-7 which are not permuted [ a permutation or ] may be formed.).]

[0018] Furthermore, this invention relates to the organic electroluminescent element which is a layer containing the above-mentioned luminescent material for organic electroluminescent elements in the organic electroluminescent element which comes to form the organic compound thin film of two or more layers which contains a luminous layer or a luminous layer in inter-electrode [ of a pair ].

[Embodiment of the Invention]

[0019] A of the compound shown by the general formula [1] in this invention, the general formula [4], or the general formula [5] The divalent ring radical which is not permuted [ a permutation or ], a fused aromatic ring radical, a complex ring radical, condensation complex ring radicals, those congeners, or two or more sorts of 2-10 different ring structure units are direct -- it is -- carrying out -- one carbon -- The divalent radical connected

through the shape of a chain and non-ring structural unit containing oxygen, nitrogen, a sulfur atom or a chain, and a hetero atom is expressed. Here, the part combined with the nitrogen atom of A has a ring structure. [0020] As an example of A, benzene, toluene, a xylene, ethylbenzene, Naphthalene, an anthracene (however, the case where it combines at least with 9 and 10- is removed), A phenanthrene, a fluorene, a pyrene, a chrysene, a naphthacene, perylene, an azulene and full -- me -- the divalent residue of the aromatic series ring which is not permuted [ permutations, such as non, anthraquinone, dibenzo SUBERONON, and tetracyano quinodimethan, or ] or a fused aromatic ring -- Or a furan, a thiophene, a pyrrole, a pyridine, a pyrone, oxazole, Pyrazine, OKISA diazole, triazole, thiadiazole, Indore, A quinoline, an isoquinoline, a carbazole, an acridine, a thioxan ton, It is the divalent residue of complex rings, such as a coumarin, acridone, diphenylene sulfone, quinoxaline, benzothiazole, phenazine, a phenanthroline, phenothiazin, Quinacridone, flavan SURON, and indan SURON, or a condensation complex ring. Furthermore, a biphenyl, terphenyl, binaphthyl, BIFURUORENIRIDEN, A bipyridine, biquinoline, a flavone, phenyl triazine, bis-benzothiazole, Bithiophene, phenylbenzo triazole, phenyl benzimidazole A phenyl acridine, a screw (benzoxazolyl) thiophene, screw (phenyl oxazolyl) benzene, Biphenyl phenyl OKISA diazole, a diphenyl benzoquinone, Diphenyl iso benzofuran, a diphenyl pyridine, a stilbene, dibenzyl, Diphenylmethane, screw (phenyl isopropyl) benzene, a diphenyl fluorene, Diphenyl hexafluoropropane, a dibenzyl naphthyl ketone, a JIBEN zylidene cyclohexanone, JISUCHIRIRU naphthalene, benzyl (phenylethyl) naphthalene, diphenyl ether, A methyl diphenylamine, a benzophenone, benzoic-acid phenyl, a diphenylurea, A diphenyl sulfide, diphenylsulfone, a JIFENOKISHI biphenyl, A screw (phenoxyphenyl) sulfone, a screw (phenoxyphenyl) propane, It is the divalent residue which has the frame which congener, such as JIFENOKISHI benzene, ethylene glycol diphenyl ether, neopentyl glycol diphenyl ether, dipicolylamine, and a dipyridyl amine, or two or more sorts of two or more different ring structure units connected.

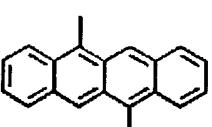
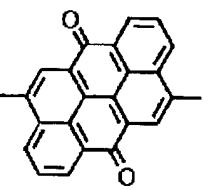
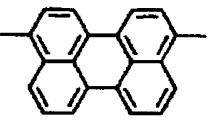
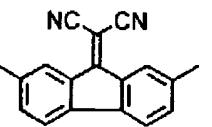
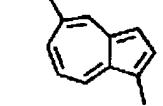
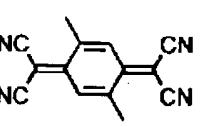
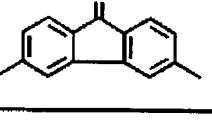
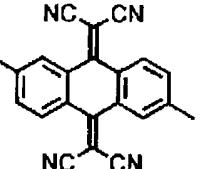
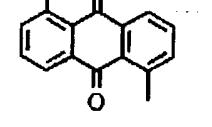
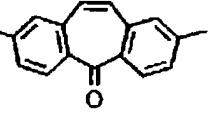
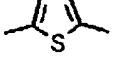
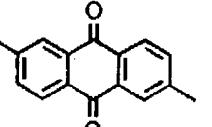
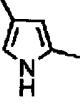
[0021] Although the example of representation of the structure of A of a being [ it / the luminescent material of this invention ] compound is illustrated concretely below in Table 1, this invention is not limited to this example of representation.

[0022]

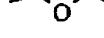
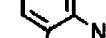
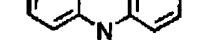
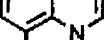
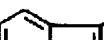
[Table 1]

2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-1)		(A-9)	
(A-2)		(A-10)	
(A-3)		(A-11)	
(A-4)		(A-12)	
(A-5)		(A-13)	
(A-6)		(A-14)	
(A-7)		(A-15)	
(A-8)			

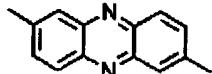
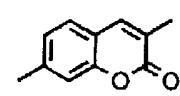
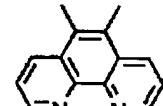
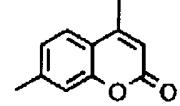
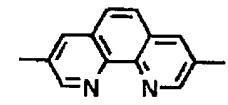
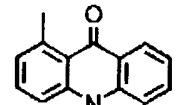
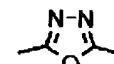
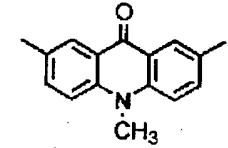
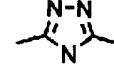
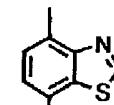
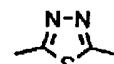
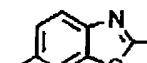
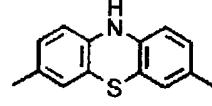
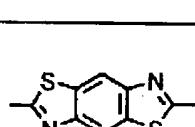
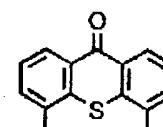
[0023]

2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-16)		(A-23)	
(A-17)		(A-24)	
(A-18)		(A-25)	
(A-19)		(A-26)	
(A-20)		(A-27)	
(A-21)		(A-28)	
(A-22)		(A-29)	

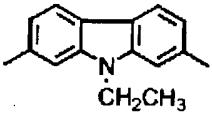
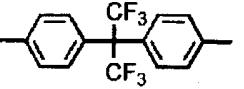
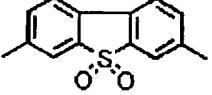
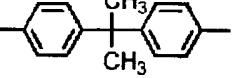
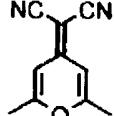
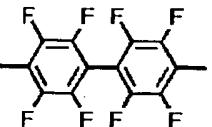
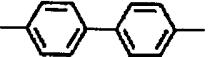
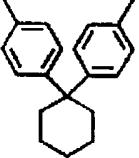
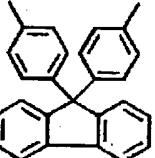
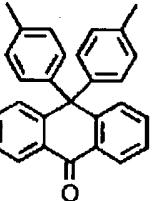
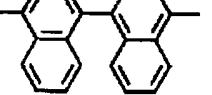
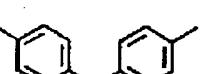
[0024]

2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-30)		(A-38)	
(A-31)		(A-39)	
(A-32)		(A-40)	
(A-33)		(A-41)	
(A-34)		(A-42)	
(A-35)		(A-43)	
(A-36)		(A-44)	
(A-37)		(A-45)	

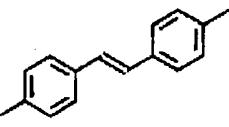
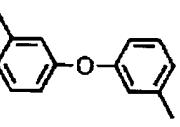
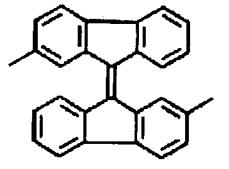
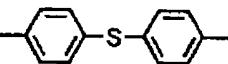
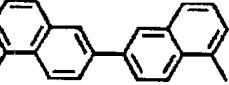
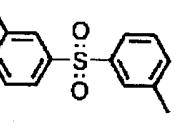
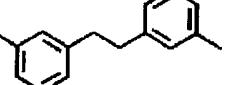
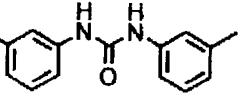
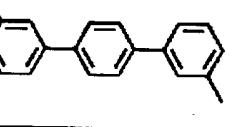
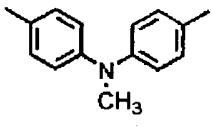
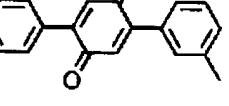
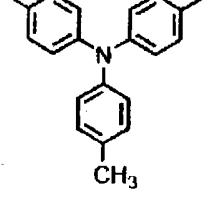
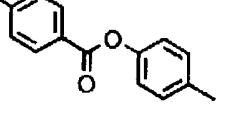
[0025]

2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-46)		(A-54)	
(A-47)		(A-55)	
(A-48)		(A-56)	
(A-49)		(A-57)	
(A-50)		(A-58)	
(A-51)		(A-59)	
(A-52)		(A-60)	
(A-53)			

[0026]

2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-61)		(A-69)	
(A-62)		(A-70)	
(A-63)		(A-71)	
(A-64)		(A-72)	
(A-65)		(A-73)	
(A-66)		(A-74)	
(A-67)			
(A-68)			

[0027]

2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-75)		(A-82)	
(A-76)		(A-83)	
(A-77)		(A-84)	
(A-78)		(A-85)	
(A-79)		(A-86)	
(A-80)		(A-87)	
(A-81)			

[0028]

2価基	化学構造(-A-)	2価基	化学構造(-A-)
(A-88)		(A-95)	
(A-89)		(A-96)	
(A-90)		(A-97)	
(A-91)		(A-98)	
(A-92)		(A-99)	
(A-93)		(A-100)	
(A-94)		(A-101)	
		(A-102)	

[0029]

2価基	化 学 構 造 (-A-)
(A-103)	
(A-104)	
(A-105)	
(A-106)	
(A-107)	
(A-108)	

[0030]

2価基	化学構造(-A-)
(A-109)	
(A-110)	
(A-111)	
(A-112)	
(A-113)	
(A-114)	
(A-115)	
(A-116)	

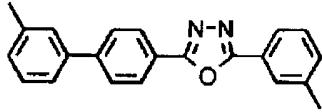
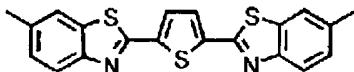
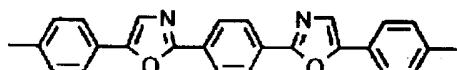
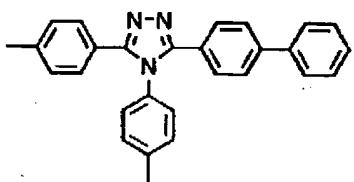
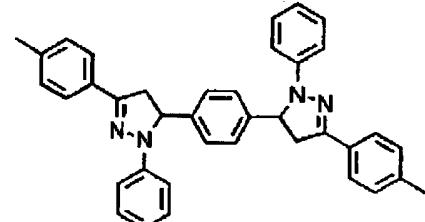
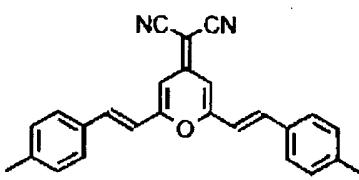
[0031]

2価基	化 学 構 造 (-A-)
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(A-118)	
(A-119)	
(A-120)	
(A-121)	
(A-122)	
(A-123)	

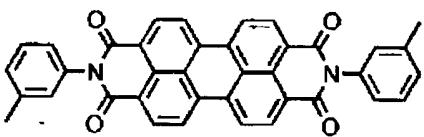
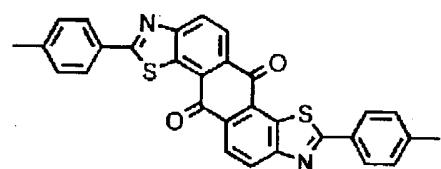
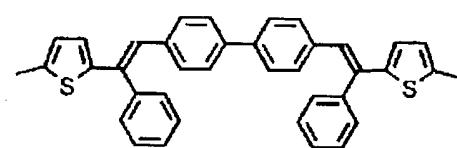
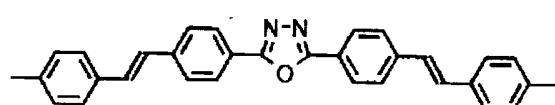
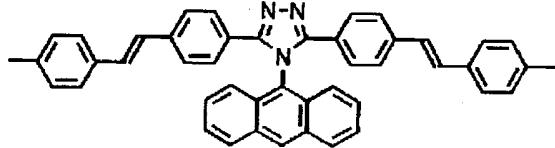
[0032]

2価基	化 学 構 造 (-A-)
(A-124)	
(A-125)	
(A-126)	
(A-127)	
(A-128)	
(A-129)	

[0033]

2価基	化 学 構 造 (-A-)
(A-130)	
(A-131)	
(A-132)	
(A-133)	
(A-134)	
(A-135)	

[0034]

2価基	化 学 構 造 (-A-)
(A-136)	
(A-137)	
(A-138)	
(A-139)	
(A-140)	

[0035] Ar1 -Ar4 of the compound shown by the general formula [1] in this invention The fused aromatic ring radical which is not permuted [ the divalent ring radical which is not permuted / a permutation or /, a permutation, or ] is expressed independently, respectively. Ar1 -Ar4 An example is the divalent residue of the aromatic series ring which is not permuted [ permutations, such as benzene, toluene, a xylene, ethylbenzene, naphthalene, an anthracene, a phenanthrene, a fluorene, a pyrene, a chrysene, a naphthacene, perylene and an azulene or ] or a fused aromatic ring. Moreover, R1 -R20 of the compound shown by the general formula [1], the general formula [4], or the general formula [5] express independently the amino group which is not permuted [ the aryl group which is not permuted / the alkoxy group which is not permuted / the alkyl group which is not permuted / a hydrogen atom a halogen atom, a permutation, or /, a permutation, or /, a permutation, or /, a permutation, or ], respectively.

[0036] A or Ar1 -Ar4 The substituent which it has, and the example of R1 -R20 As a halogen atom, as an alkyl group which is not permuted [ fluorine, chlorine, a bromine, iodine, a permutation, or ] A methyl group, an ethyl group, a propyl group, butyl, sec-butyl, tert-butyl, A pentyl radical, a hexyl group, a heptyl radical, an octyl radical, a stearyl radical, 2-phenyl isopropyl group, a TORIKURORO methyl group, a trifluoromethyl radical, There are benzyl, alpha-phenoxy benzyl, alpha, and alpha-dimethylbenzyl radical, alpha, and alpha-methylphenyl benzyl, alpha, and alpha-difluoromethyl benzyl, a triphenylmethyl radical, an alpha-

benzyloxybenzyl radical, etc. As an alkoxy group which is not permuted [ a permutation or ], there are a methoxy group, an ethoxy radical, a propoxy group, an n-butoxy radical, a t-butoxy radical, n-octyloxy radical, t-octyloxy radical, 1 and 1, 1-tetrafluoro ethoxy radical, a phenoxy group, a benzyloxy radical, an octyl phenoxy group, etc. As an aryl group which is not permuted [ a permutation or ], there are a phenyl group, 2-methylphenyl radical, 3-methylphenyl radical, 4-methylphenyl radical, 4-ethyl phenyl group, a biphenyl radical, 4-methyl biphenyl radical, 4-ethyl biphenyl radical, 4-cyclohexyl biphenyl radical terphenyl radical, 3, 5-dichlorophenyl radical, a naphthyl group, 5-methyl naphthyl group, an anthryl radical, a pyrenyl radical, etc. As an amino group which is not permuted [ a permutation or ], there are the amino group, a dimethylamino radical, a diethylamino radical, a phenyl methylamino radical, a diphenylamino radical, a ditolylamino radical, a dibenzylamino radical, etc. Moreover, by adjoining substituents, it may join together mutually, respectively and the cyclopentene ring which is not permuted [ a permutation or, a cyclohexene ring, a phenyl ring, a naphthalene ring, an anthracene ring, a pyrene ring, a fluorene ring, a furan ring, a thiophene ring, a pyrrole ring, an oxazole ring, a thiazole ring, an imidazole ring, a pyridine ring, a pyrazine ring, a pyrrolidine ring a pyrazoline ring, the Indore ring, a quinoline ring, a quinoxaline ring, a xanthene ring, a carbazole ring, an acridine ring, a phenanthroline ring, etc. may newly be formed.

[0037] X1 -X4 of the compound shown by the general formula [1] or general formula [4] in this invention Independently, respectively -O-, -S-, >C=O, >SO<sub>2</sub>, -(Cx H<sub>2x</sub>)-O-(Cy H<sub>2y</sub>)-, The divalent radical of the aliphatic series ring which is not permuted [ a with a carbon numbers of two or more which are not permuted / a with a carbon numbers of two or more which are not permuted / a permutation or / alkylidene radical, a permutation, or / alkylene group, a permutation, or ] is expressed. Here, although x and y express the positive integer of 0-20, they are not set to x+y=0. Y1-Y8 of the compound shown by the general formula [5] in this invention The aromatic series ring machine of the carbon numbers 6-16 which are not permuted [ the alkyl group of the carbon numbers 1-20 which are not permuted / a permutation or /, a permutation, or ] is expressed. Moreover, Y1 Y2 and Y3 Y4 and Y5 Y6 and Y7 Y8 The aliphatic series ring machine of the carbon numbers 5-7 which are not permuted [ a permutation or ] may be formed. The alkyl group and aromatic series ring machine which described the example of an alkyl group and an aromatic series ring machine by above R1 -R20 are mentioned. Moreover, as for the aliphatic series ring machine of the carbon numbers 5-7 which may be formed, a cyclopentylic group, a cyclohexyl radical, 4-methylcyclohexyl radical, a cycloheptyl radical, etc. are mentioned.

[0038] Although the example of representation of the radical (part of benzene ring-Xn-Arn- of a permutation or un-permuting in a general formula [1]) of the outside of the nitrogen atom of the compound of the general formula [1] of this invention, a general formula [4], or a general formula [5] is concretely illustrated to Table 2 below, this invention is not limited to this example of representation.

[0039]

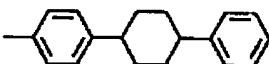
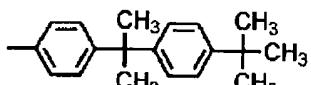
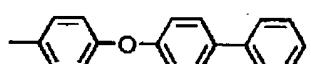
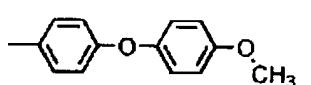
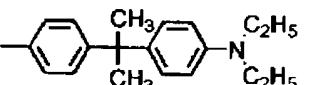
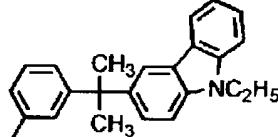
[Table 2]

1価基	化 学 構 造	1価基	化 学 構 造
(B-1)		(B-7)	
(B-2)		(B-8)	
(B-3)		(B-9)	
(B-4)		(B-10)	
(B-5)		(B-11)	
(B-6)		(B-12)	

[0040]

1価基	化学構造	1価基	化学構造
(B-13)		(B-19)	
(B-14)		(B-20)	
(B-15)		(B-21)	
(B-16)		(B-22)	
(B-17)		(B-23)	
(B-18)		(B-24)	

[0041]

1価基	化 学 構 造
(B-25)	
(B-26)	
(B-27)	
(B-28)	
(B-29)	
(B-30)	

[0042] \*\* with the compound big [ molecular weight ] in this invention -- since it has a high radical, a glass transition point and the melting point become high. Moreover, as for the compound which forms the aromatic series ring by the substituents which R1 -R20 adjoin, a glass transition point and the melting point become high further. For this reason, when it is used as a luminescent material of an organic EL device, since the resistance (thermal resistance) over the Joule's heat generated between the organic layers in the organic layer at the time of electroluminescence or between an organic layer and a metal electrode improves, also in case long duration luminescence is carried out, it is advantageous [ high luminescence brightness is shown, and ].

[0043] The general synthetic approach of the compound shown by the general formula [1] of this invention, the general formula [4], or the general formula [5] is shown below. The secondary amine derivative, the potassium carbonate, and the catalyst which are the structure which permuted from hydrogen association with the nitrogen atom of the dihalogen ghost of divalent residue, a general formula [1], a general formula [4], or a general formula [5] and A which hit A of a general formula [1], a general formula [4], or a general formula [5] can be made to be able to react in a solvent, and the compound of a general formula [1] a general formula [4], or a general formula [5] can be compounded There are some which replace with the dihalogen ghost of A structure and can be compounded from the dicarbonyl compound of A structure. It can replace with potassium carbonate and a sodium carbonate, a potassium hydroxide, a sodium hydroxide, or aqueous ammonia can be used. As a

catalyst, there is \*\*\*\*, a cuprous chloride, tin, a stannous chloride, a pyridine, 3 aluminum chlorides, or a titanium tetrachloride. A solvent has benzene, toluene, or a xylene. The above synthesis method is an example and is not limited especially.

[0044] Although the example of representation of the luminescent material of this invention is concretely illustrated to Table 3 below, this invention is not limited to this example of representation.

[0045]

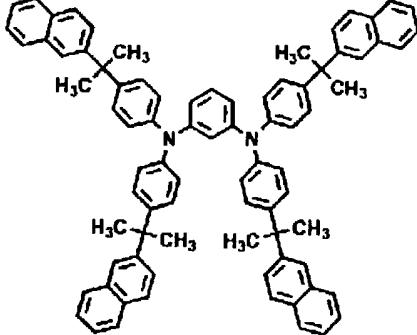
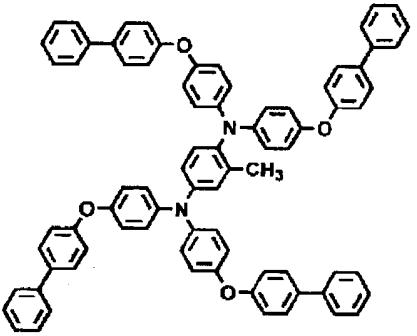
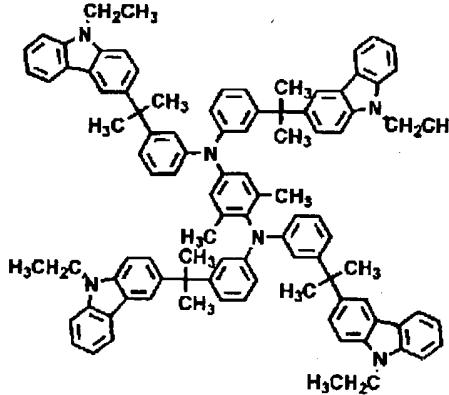
[Table 3]

化合物	化 学 構 造
(1)	
(2)	
(3)	

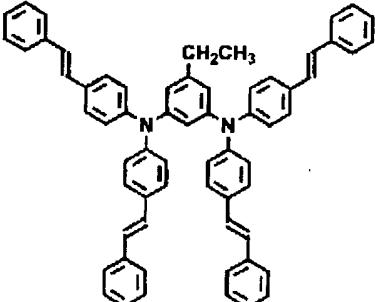
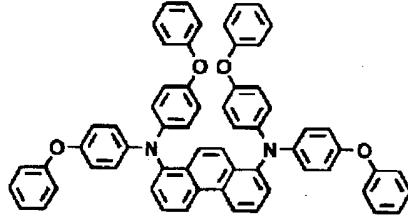
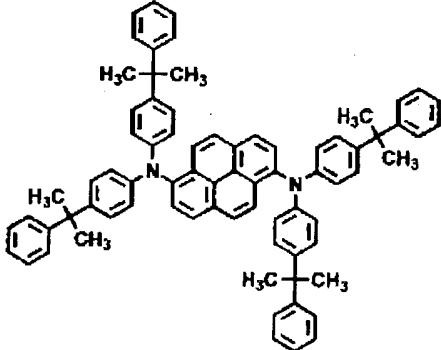
[0046]

化合物	化 学 構 造
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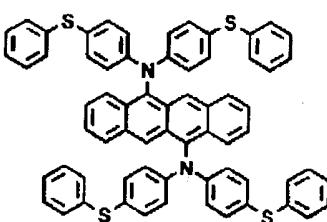
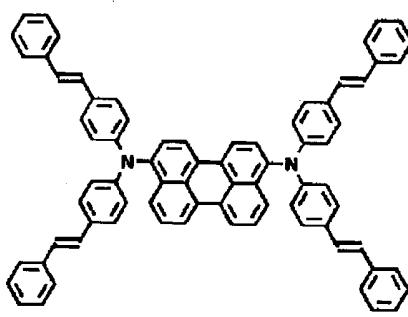
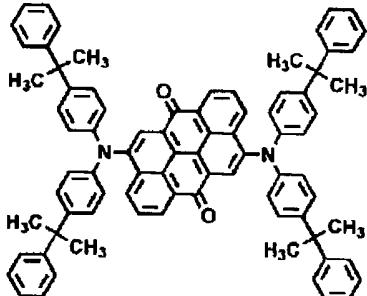
[0047]

化合物	化 学 構 造
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(8)	
(9)	

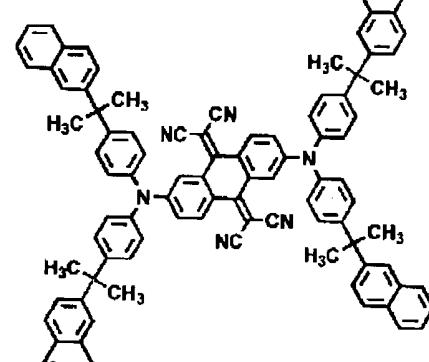
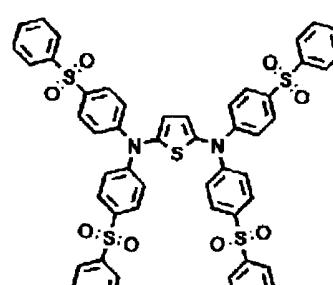
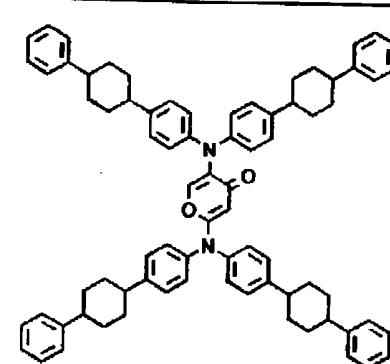
[0048]

化合物	化 学 構 造
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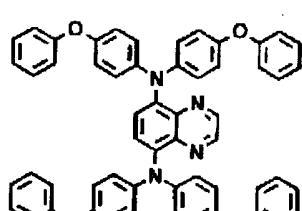
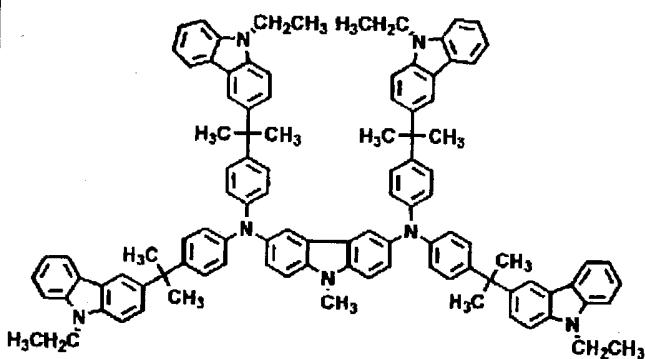
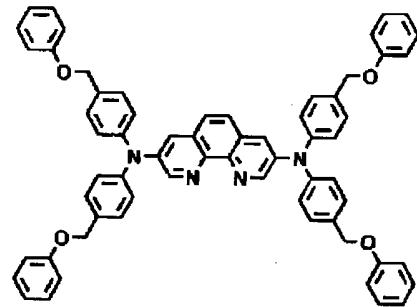
[0049]

化合物	化 学 构 造
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(14)	
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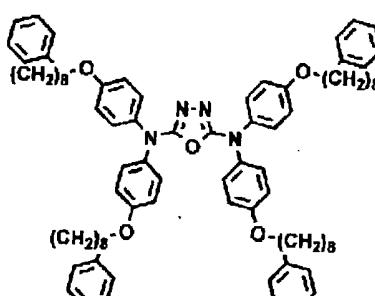
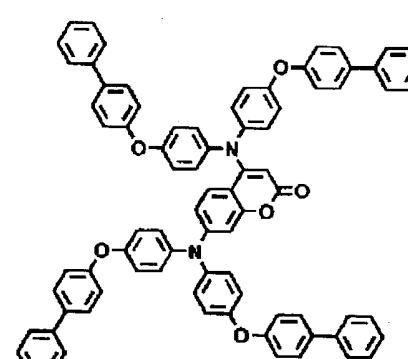
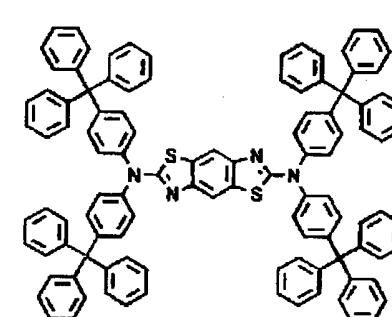
[0050]

化合物	化 学 構 造
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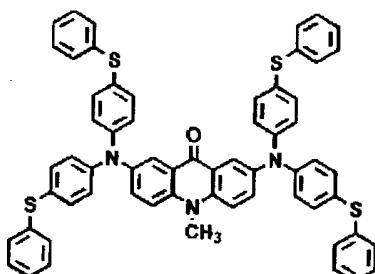
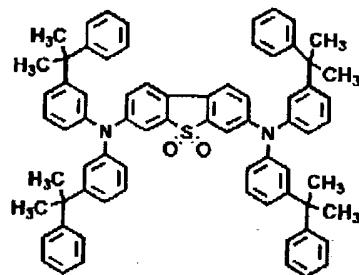
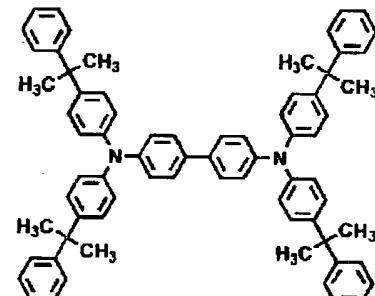
[0051]

化合物	化 学 構 造
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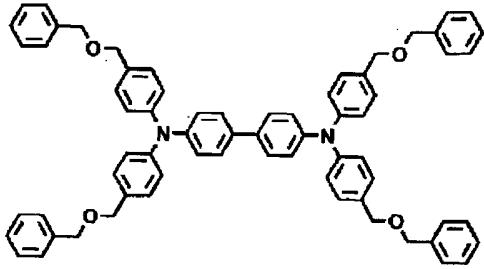
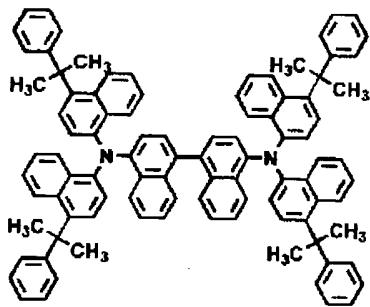
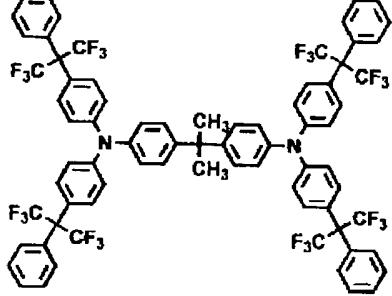
[0052]

化合物	化 学 構 造
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(24)	

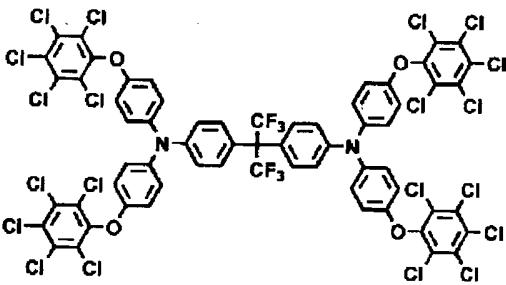
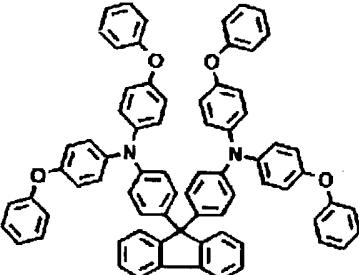
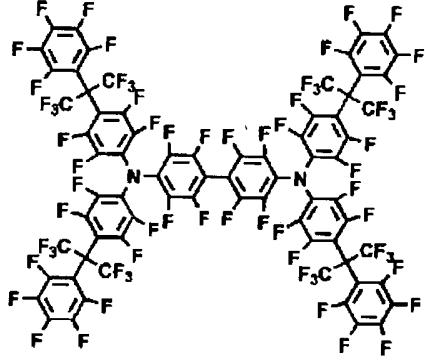
[0053]

化合物	化 学 構 造
(25)	
(28)	
(27)	

[0054]

化合物	化 学 構 造
(28)	
(29)	
(30)	

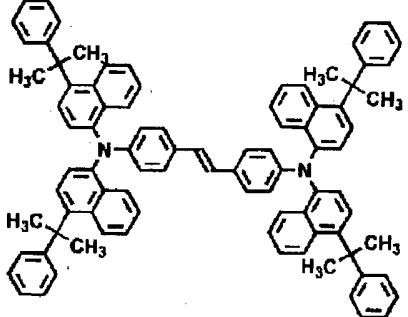
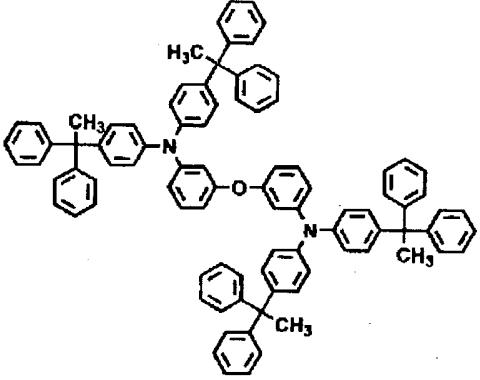
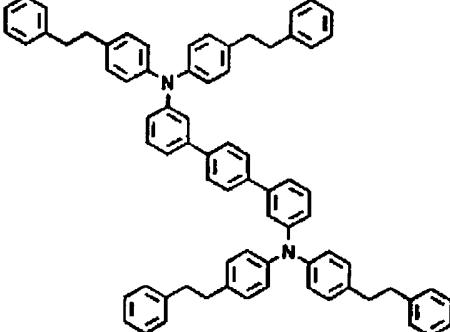
[0055]

化合物	化 学 構 造
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(32)	
(33)	

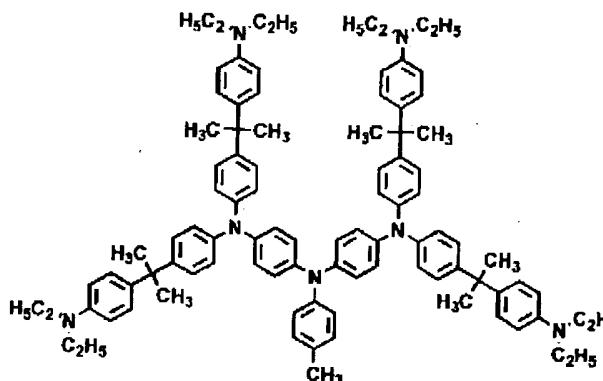
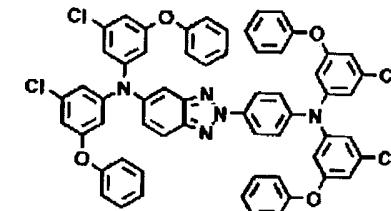
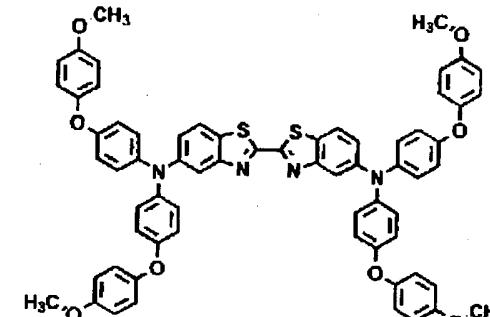
[0056]

化合物	化 学 構 造
(34)	
(35)	
(36)	

[0057]

化合物	化学構造
(37)	
(38)	
(39)	

[0058]

化合物	化 学 構 造
(40)	 <p>Chemical structure (40) is a triphenylamine derivative. It features a central triphenylamine core with two dimethylaminophenyl groups attached at the 4 and 4' positions. Each dimethylaminophenyl group is further substituted with a triethylammonium cation (<math>\text{H}_3\text{C}_2\text{N}^+ \text{C}_2\text{H}_5</math>).</p>
(41)	 <p>Chemical structure (41) is a bis(4-chlorophenyl)-bis(4-phenylphenylamine derivative. It consists of a central nitrogen atom bonded to two 4-chlorophenyl groups. This central nitrogen is also bonded to two 4-phenylphenylamine groups, which are further substituted with 4-chlorophenyl groups.</p>
(42)	 <p>Chemical structure (42) is a bis(4-methoxyphenyl)-bis(4-phenylphenylamine derivative. It features a central nitrogen atom bonded to two 4-methoxyphenyl groups. This central nitrogen is also bonded to two 4-phenylphenylamine groups, which are further substituted with 4-methoxyphenyl groups.</p>

[0059]

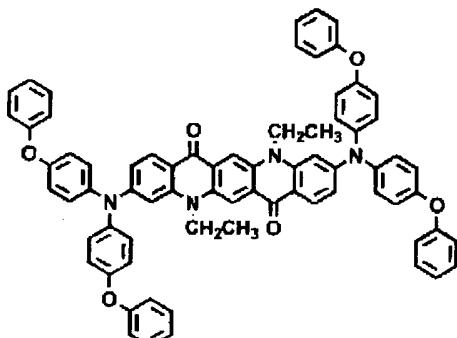
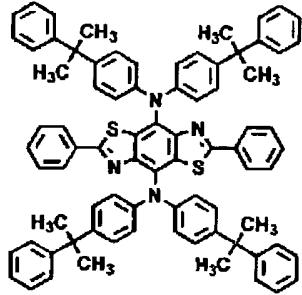
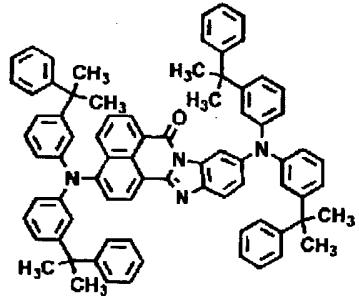
化合物	化 学 构 造
(43)	
(44)	
(45)	

[0060]

[0061]

化合物	化 学 構 造
(49)	
(50)	
(51)	

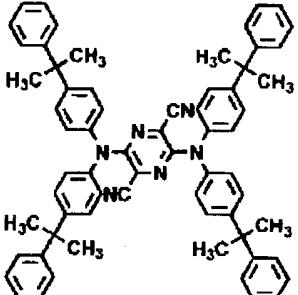
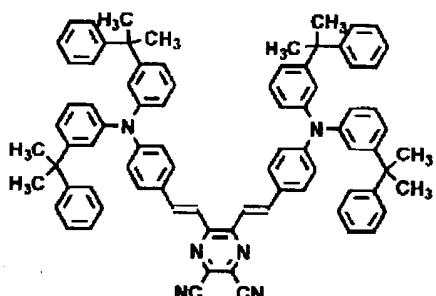
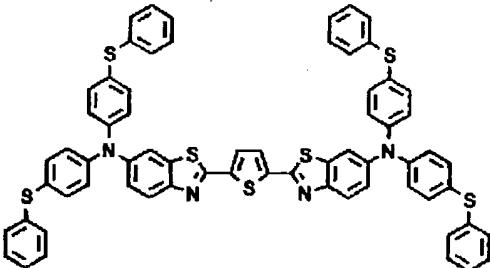
[0062]

化合物	化 学 構 造
(52)	
(53)	
(54)	

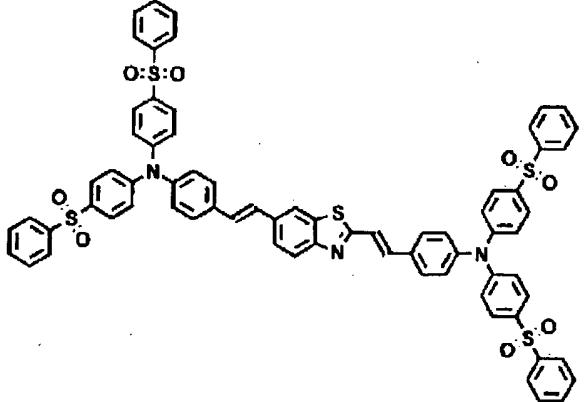
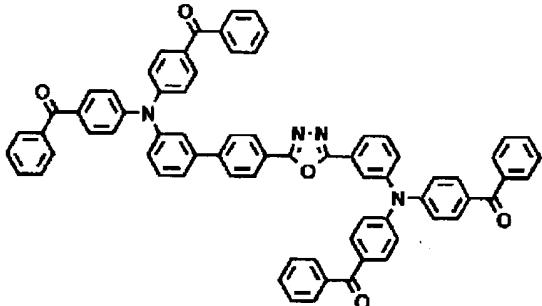
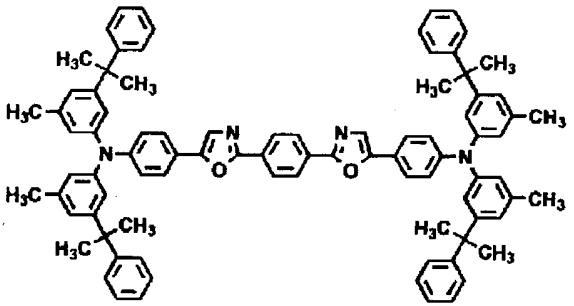
[0063]

化合物	化 学 构 造
(55)	
(56)	
(57)	

[0064]

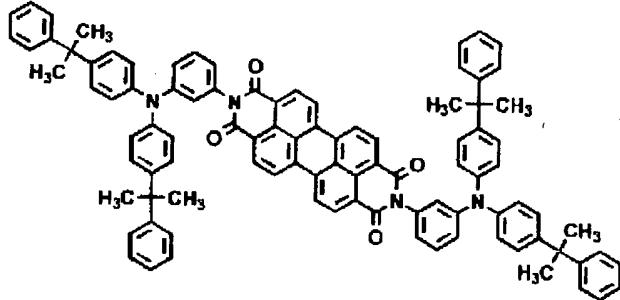
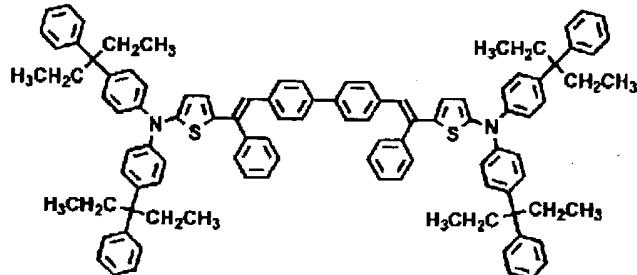
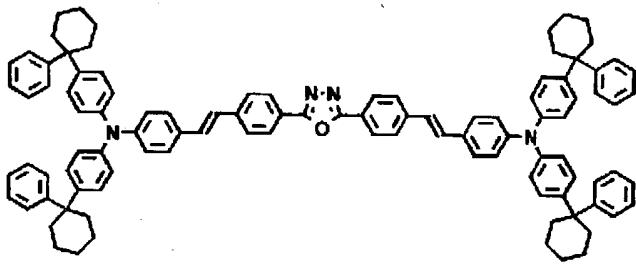
化合物	化 学 構 造
(58)	
(59)	
(60)	

[0065]

化合物	化 学 構 造
(61)	
(62)	
(63)	

[0066]

[0067]

化合物	化 学 构 造
(67)	
(68)	
(69)	

[0068]

化合物	化 学 構 造
(70)	
(71)	
(72)	

[0069]

化合物	化 学 構 造
(73)	
(74)	
(75)	

[0070]

化合物	化 学 構 造
(76)	
(77)	
(78)	

[0071]

化合物	化 学 構 造
(79)	
(80)	
(81)	

[0072]

化合物	化 学 構 造
(82)	
(83)	
(84)	

[0073] The compound which is the luminescent material of this invention is a compound which has strong fluorescence in a solid state, and is excellent also in electroluminescence nature. Moreover, since it has collectively the hole-injection nature which was excellent from the metal electrode and electron hole transportability, the electron injection nature which was excellent from the metal electrode, and electronic transportability with it, it can be effectively used as a luminescent material, and even if it uses the electron hole transportability ingredient, electronic transportability ingredient, or doping ingredient of further others, it does not interfere.

[0074] An organic EL device is a component in which one layer or a multilayer organic thin film was formed between an anode plate and cathode. In the case of the mold, the luminous layer is further prepared between an anode plate and cathode. A luminous layer contains luminescent material, and in order to make the electron hole which was poured in from the anode plate in addition to it, or the electron poured in from cathode convey to luminescent material, it may contain a hole-injection ingredient or an electron injection ingredient. However, since the luminescent material of this invention has very high luminescence quantum efficiency, high electron hole transport capacity, and electronic transport capacity and can form a uniform thin film, it can also form a luminous layer only by the luminescent material of this invention. A multilayer mold has the organic EL device which carried out the laminating with the multilayer configuration of (an anode plate / hole-injection band /

luminous layer / cathode), (an anode plate / luminous layer / electron injection band / cathode), and (an anode plate / hole-injection band / luminous layer / electron injection band / cathode). Since the compound which is the luminescent material of this invention has a high luminescence property and has hole-injection nature, electron hole transport properties and electron injection nature, and electronic transport properties, it can be used for a luminous layer as a luminescent material.

[0075] If there is need, in addition to the compound which is the luminescent material of this invention, the further well-known luminescent material, a doping ingredient, a hole-injection ingredient, and an electron injection ingredient can also be used for a luminous layer. An organic EL device can prevent the fall of the brightness by quenching, or a life by making it multilayer structure. If there is need, it can be used combining luminescent material, a doping ingredient, a hole-injection ingredient, or an electron injection ingredient.

Moreover, improvement in luminescence brightness or luminous efficiency, and red and blue luminescence can also be obtained with a doping ingredient. Moreover, a hole-injection band, a luminous layer, and an electron injection band may be formed of the lamination more than a bilayer, respectively. In the case of a hole-injection band, in that case, the layer which conveys [ the layer which pours in an electron hole from an electrode ] an electron hole for an electron hole from a hole-injection layer and a hole-injection layer to a reception luminous layer is called an electron hole transportation layer. Similarly, in the case of an electron injection band, the layer which conveys [ the layer which pours in an electron from an electrode ] an electron for an electron from an electron injection layer and an electron injection layer to a reception luminous layer is called an electronic transportation layer. These each class is used by each factor, such as adhesion with the energy level of an ingredient, thermal resistance, an organic layer, or a metal electrode, choosing it.

[0076] As the luminescent material which can be used for a luminous layer with the luminescent material of this invention, or a doping ingredient An anthracene, naphthalene, a phenanthrene, a pyrene, tetracene, Coronene, a chrysene, a fluorescein, perylene, phtalo perylene, Non [ naphthalo perylene and peri non, / phtalo peri non, / naphthalo peri ] A diphenyl butadiene, a tetra-phenyl butadiene, a coumarin, OKISA diazole, Aldazine, bis-benzo KISAZORIN, bis-styryl, pyrazine, a cyclopentadiene, A quinoline metal complex, an amino quinoline metal complex, a benzoquinoline metal complex, Although there are an imine, diphenylethylene, a vinyl anthracene, a diamino carbazole, a pyran, thiopyran, poly methine, merocyanine, an imidazole chelation oxy-NOIDO compound, Quinacridone, rubrene and an object for dye laser, a fluorochrome for brightening, etc. It is not limited to these.

[0077] Anything of the rate of an abundance ratio in the inside of the luminous layer of the above-mentioned compound which can be used for a luminous layer with the luminescent material of this invention may be a principal component. That is, the compound in this invention can grow also into the DOPINKU ingredient to the inside of other charges of a principal member also at the charge of a principal member which forms a luminous layer with each combination of the above-mentioned compound and the compound in this invention.

[0078] The compound which has the capacity to convey an electron hole, as a hole-injection ingredient, has the hole-injection effectiveness which was excellent to the hole-injection effectiveness, the luminous layer, or luminescent material from an anode plate, and prevented migration into the electron injection band or electron injection ingredient of an exciton generated by the luminous layer, and was excellent in the thin film organization potency force is mentioned. Specifically A phthalocyanine derivative, a naphthalocyanine derivative, a porphyrin derivative, Oxazole, OKISA diazole, triazole, an imidazole, imidazolone, Imidazole thione, pyrazoline, a pyrazolone, a tetrahydro imidazole, Oxazole, OKISA diazole, a hydrazone, an acyl hydrazone, The poly aryl alkane, a stilbene, a butadiene, a benzidine mold triphenylamine, a styryl amine mold triphenylamine, a diamine mold triphenylamine, etc., Although there are polymeric materials, such as those derivatives and a polyvinyl carbazole, polysilane, and a conductive polymer, etc., it is not limited to these.

[0079] The still more effective hole-injection ingredient in the hole-injection ingredient which can be used in the organic EL device of this invention is the third class amine derivative of aromatic series, or a phthalocyanine derivative. As an example of the third class amine derivative of aromatic series, a triphenylamine, a tritolyl amine, a tolyl diphenylamine, N, and N' - diphenyl-N and N' - JI (3-methylphenyl) -1 and 1' -- the - biphenyl -4 and 4' - diamine -- N, N, N', and N' -- the - tetrapod (4-methylphenyl) -1 and 1' -- the - phenyl -4 and 4' - diamine -- N, N, N', and N' -- the - tetrapod (4-methylphenyl) -1 and 1' -- the - biphenyl -4 and 4' - diamine -- N and N' - diphenyl-N and N' - JI (1-naphthyl) -1 and 1' -- the - biphenyl -4 and 4' - diamine - N, N' - JI (methylphenyl)-N, the N' - JI (4-n-buthylphenyl) phenanthrene -9, 10-diamine, Although there is 4, 4', oligomer with the third class amines frame of such aromatic series, such as 4"-tris (N-(3-methylphenyl)-N-

phenylamino) triphenylamine, 1, and 1-screw (4-G p-tolylamino phenyl) cyclohexane, or a polymer It is not limited to these.

[0080] As an example of a phthalocyanine (Pc) derivative, although there are a phthalocyanine derivative, naphthalocyanine derivatives, etc., such as H2Pc, CuPc, CoPc, NiPc, ZnPc, PdPc, FePc, MnPc, ClAlPc, ClGaPc, ClInPc, ClSnPc, Cl2SiPc, (HO)AlPc, (HO)GaPc, VOPc, TiOPc, MoOPc, and GaPc-O-GaPc, it is not limited to these.

[0081] The compound which has the capacity to convey an electron, as an electron injection ingredient, has the electron injection effectiveness which was excellent to the hole-injection effectiveness, the luminous layer, or luminescent material from cathode, and prevented migration to the hole-injection band of the exciton generated by the luminous layer, and was excellent in the thin film organization potency force is mentioned. for example, full -- me -- non, although there are anthra quinodimethan, diphenoxquinone, thiopyran dioxide, oxazole, OKISA diazole, triazole, an imidazole, perylene tetracarboxylic acid, deflection ORENIRIDEN methane, anthra quinodimethan, antrones, etc. and those derivatives, it is not limited to these. Moreover, sensitization can be carried out by adding the electronic acceptance matter into a hole-injection ingredient, and adding the electron-donative matter into an electron injection ingredient.

[0082] In the organic EL device of this invention, a still more effective electron injection ingredient is a metal complex compound or a nitrogen-containing five membered ring derivative. As a metal complex compound, specifically 8-hydroxyquinolinate lithium, Bis(8-hydroxyquinolinate)zinc, bis(8-hydroxyquinolinate)copper, Screw (8-hydroxyquinolinate) manganese, tris(8-hydroxyquinolinate)aluminium, Tris (2-methyl-8-hydroxyquinolinate) aluminum, A tris (8-hydroxyquinolinate) gallium, screw (10-hydroxy benzo [h] quinolinate) beryllium, Screw (10-hydroxy benzo [h] quinolinate) zinc, a screw (2-methyl-8-quinolinate) chloro gallium, A screw (2-methyl-8-quinolinate) (o-cresolate) gallium, Screw (2-methyl-8-quinolinate) (1-naphth RATO) aluminum, A screw (2-methyl-8-quinolinate) (2-naphth RATO) gallium, Although there are a screw (2-methyl-8-quinolinate) phenolate gallium, screw (o-(2-benzoxazolyl) phenolate) zinc, screw (o-(2-benzothiazolyl) phenolate) zinc, screw (o-(2-benzo thoria ZORIRU) phenolate) zinc, etc. It is not limited to these. Moreover, as a nitrogen-containing 5 member derivative, oxazole, a thiazole, OKISA diazole, thiadiazole, or a triazole derivative is desirable. Specifically, it is 2 and 5-screw (1-phenyl) - 1, 3, 4-oxazole, 1, 4-screw (2-(4-methyl-5-phenyl oxazolyl)) benzene, 2, 5-screw (1-phenyl) - 1, 3, 4-thiazole, 2, 5-screw (1-phenyl) - 1, 3, 4-OKISA diazole, 2-(4'-tert-buthylphenyl)-5-(4"-biphenyl) 1, 3, 4-OKISA diazole, 2, 5-screw (1-naphthyl)-screw [ 1, 3, 4-OKISA diazole, 1, and 4-] [2- (5-phenyl oxadiazolyl)] benzene, 1, 4-screw [2-(5-phenyl oxadiazolyl)-4-tert-butylbenzene], 2-(4'-tert-buthylphenyl)-5-(4"-biphenyl)- 1, 3, and 4-thiadiazole -- 2, 5-screw (1-naphthyl)-screw [ 1, 3, 4-thiadiazole, 1, and 4-] [2- (5-phenyl thiadiazolyl)] benzene, 2-(4'-tert-buthylphenyl)-5-(4"-biphenyl)-, although there is 1, 3, 4-triazole, 2, and 5-screw (1-naphthyl)-screw [ 1, 3, 4-triazole, 1, and 4-] [2- (5-phenyl thoria ZORIRU)] benzene etc. It is not limited to these.

[0083] In this organic EL device, at least one sort of other luminescent material, a doping ingredient, a hole-injection ingredient, and an electron injection ingredient other than the luminescent material of this invention may contain in the same layer in a luminous layer. Moreover, it is also possible to prepare a protective layer on the surface of a component for the improvement of stability to the temperature of the organic EL device obtained by this invention, humidity, an ambient atmosphere, etc., or to protect the whole component with a silicone oil, resin, etc.

[0084] What has a bigger work function than 4eV as a conductive ingredient used for the anode plate of an organic EL device is suitable, and organic conductive resin, such as the poly thiophene and polypyrrole, is used for gold oxide groups, such as tin oxide used for those alloys, such as carbon, aluminum, vanadium, iron, cobalt, nickel, a tungsten, silver, gold, platinum, and palladium, and an ITO substrate, and a NESA substrate, and indium oxide, and a pan.

[0085] Although what has a work function smaller than 4eV as conductive matter used for cathode is suitable and those alloys, such as magnesium, calcium, tin, lead, titanium, an yttrium, a lithium, a ruthenium, manganese, and aluminum, are used, it is not limited to these. As an alloy, although magnesium/silver, magnesium/indium, a lithium/aluminum, etc. are mentioned as an example of representation, it is not limited to these. The ratio of an alloy is controlled by the temperature of the source of vacuum evaporationo, the ambient atmosphere, a degree of vacuum, etc., and is chosen as a suitable ratio. As long as an anode plate and cathode have the need, they may be formed of the lamination more than a bilayer.

[0086] In order to make light emit efficiently in an organic EL device, as for at least one side, it is desirable to

make it transparency enough in the luminescence wavelength field of a component. Moreover, the transparent thing of a substrate is desirable. The above-mentioned conductive ingredient is used for a transparent electrode, and it sets it up so that predetermined translucency may secure by approaches, such as vacuum evaporation and sputtering. As for the electrode of a luminescence side, it is desirable to make light transmittance 10% or more. If a substrate has mechanical and thermal reinforcement and it has transparency, it is not limited, but if it illustrates, transparency resin, such as a glass substrate, a polyethylene plate, a polyethylene TEREFUTE rate plate, a polyether ape phon plate, and a polypropylene plate, will be raised.

[0087] Formation of each class of the organic EL device concerning this invention can apply which approach of the wet forming-membranes methods, such as the dry type forming-membranes methods, such as vacuum deposition, sputtering, plasma, and ion plating, spin coating, dipping, and flow coating. Although especially thickness is not limited, it is necessary to set it as suitable thickness. If thickness is too thick, in order to obtain a fixed optical output, big applied voltage will be needed and effectiveness will worsen. If thickness is too thin, even if a pinhole etc. will occur and it will impress electric field, sufficient luminescence brightness is not obtained. The usual thickness has the still more desirable range of 0.2 micrometers from 10nm, although the range of 10 micrometers is suitable from 5nm.

[0088] The solvent may be any, although suitable solvents, such as ethanol, chloroform, a tetrahydrofuran, and dioxane, are made to dissolve or distribute the ingredient which forms each class in the case of the wet forming-membranes method and a thin film is formed. Moreover, also in which organic thin film layer, suitable resin and a suitable additive may be used on a membrane formation disposition for pinhole prevention of the film etc. As possible resin of use, conductive resin, such as photoconductivity resin, such as insulating resin, such as polystyrene, a polycarbonate, polyarylate, polyester, a polyamide, polyurethane, polysulfone, polymethylmethacrylate, polymethyl acrylate, and a cellulose, and those copolymers, Polly N-vinylcarbazole, and polysilane, the poly thiophene, and polypyrrole, can be mentioned. Moreover, an antioxidant, an ultraviolet ray absorbent, a plasticizer, etc. can be mentioned as an additive.

[0089] As mentioned above, organic EL device properties, such as luminous efficiency and the maximum luminescence brightness, were improvable by using the compound of this invention for the luminous layer of an organic EL device. Moreover, since it was very stable and usable luminescence brightness was obtained practical by still lower driver voltage to heat or a current, this component was also able to reduce sharply degradation which was a big problem to the former.

[0090] The organic EL device of this invention can consider application as a flat-panel display and flat-surface illuminants, such as a flat TV, to the light source of the light source of a copying machine, a printer, etc., a liquid crystal display, instruments, etc., the plotting board, a beacon light, etc., and the industrial value is very large.

[0091] The ingredient of this invention can be used also in fields, such as an organic EL device, an electrophotography photo conductor, an optoelectric transducer, a solar battery, and image sensors.

[0092]

[Example] Hereafter, this invention is further explained to a detail based on an example.

On the glass plate with an ITO electrode washed example 1, it is compound [ of Table 3 ] (1), 2, and 5-screw (1-naphthyl) as a luminescent material. - 1, 3, 4-OKISA diazole, and polycarbonate resin (Teijin formation : panlight K-1300) were dissolved in the tetrahydrofuran by the weight ratio of 5:3:2, and the luminous layer of 100nm of thickness was obtained with the spin coating method. The electrode of 150nm of thickness was formed with the alloy which moreover mixed the indium with magnesium by 10:1, and the organic EL device was obtained. As for the luminescence property of this component, blue luminescence of 90 (cd/m<sup>2</sup>), the highest brightness 1500 (cd/m<sup>2</sup>), and luminous efficiency 0.50 (lm/W) was obtained by direct-current-voltage 5V.

[0093] On the glass plate with an ITO electrode washed example 2, vacuum deposition of the compound (2) of Table 3 was carried out, the luminous layer of 100nm of thickness was created, the electrode of 100nm of thickness was formed with the alloy which mixed silver with magnesium by 10:1 on it, and the organic EL device was obtained. The luminous layer was vapor-deposited under the conditions of a substrate temperature room temperature in the vacuum of 10-6Torr. As for this component, green luminescence of 260 (cd/m<sup>2</sup>), the highest brightness 800 (cd/m<sup>2</sup>), and luminous efficiency 0.60 (lm/W) was obtained by direct-current-voltage 5V.

[0094] On the glass plate with an ITO electrode washed example 3, the compound (3) of Table 3 was dissolved

in the methylene chloride, and the luminous layer of 50nm of thickness was obtained with the spin coating method. Subsequently, vacuum deposition of the screw (2-methyl-8-quinolinate) (2-naphth RATO) aluminum was carried out, the electron injection layer of 10nm of thickness was created, the electrode of 100nm of thickness was formed on it with the alloy which mixed aluminum with magnesium by 10:1, and the organic EL device was obtained. The luminous layer and the electron injection layer were vapor-deposited under the conditions of a substrate temperature room temperature in the vacuum of 10-6Torr. As for this component, bluish green color luminescence of 200 (cd/m<sup>2</sup>), the highest brightness 12000 (cd/m<sup>2</sup>), and luminous efficiency 1.2 (lm/W) was obtained by direct-current-voltage 5V.

[0095] On the glass plate with an ITO electrode washed example 4, vacuum deposition of the compound (2) of Table 3 was carried out, and the luminous layer was formed at 50nm of thickness. Subsequently, vacuum deposition of the tris(8-hydroxyquinolinate)aluminum was carried out, the electron injection layer of 10nm of thickness was created, the electrode of 100nm of thickness was formed on it with the alloy which mixed aluminum and a lithium by 50:1, and the organic EL device was obtained. The hole-injection layer and the luminous layer were vapor-deposited under the conditions of a substrate temperature room temperature in the vacuum of 10-6Torr. As for this component, green luminescence of about 150 (cd/m<sup>2</sup>), the highest brightness 9000 (cd/m<sup>2</sup>), and luminous efficiency 1.1 (lm/W) was obtained by direct-current-voltage 5V.

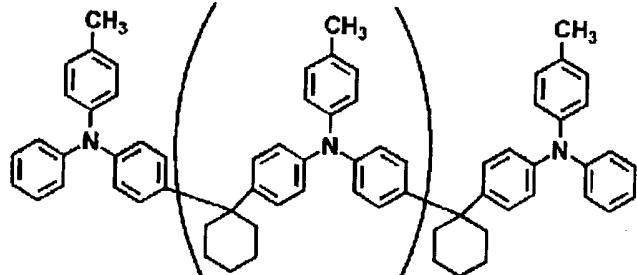
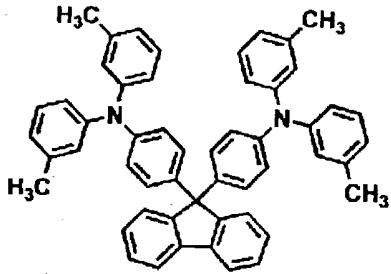
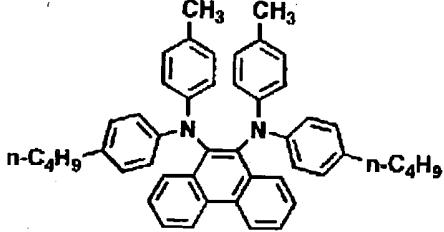
[0096] Vacuum deposition of the one sort in the hole-injection ingredient of Table 4 was carried out on the glass plate with an ITO electrode washed example 5-83, and the hole-injection layer of 30nm of thickness was obtained. Subsequently, vacuum deposition of the one sort in the luminescent material of Table 3 was carried out, and the luminous layer of 30nm of thickness was obtained. Furthermore, vacuum deposition of the one sort in the electron injection ingredient of Table 4 was carried out, the electron injection layer of 30nm of thickness was created, the electrode of the thickness of 150nm of thickness was formed on it with the alloy which mixed silver with magnesium by 10:1, and the organic EL device was obtained. Each class was vapor-deposited under the conditions of a substrate temperature room temperature in the vacuum of 10-6Torr. The luminescence property of the ingredient used for each component and this component is shown in Table 5. All the organic EL devices of this example had the high brightness property more than highest brightness 5000 (cd/m<sup>2</sup>).

[0097]

[Table 4]

化合物	化 学 構 造
(H-1)	
(H-2)	
(H-3)	

[0098]

化合物	化 学 構 造
(H-4)	 <p style="text-align: center;"><math>n = 2 \sim 6</math></p>
(H-5)	
(H-6)	

[0099]

化合物	化 学 構 造	化合物	化 学 構 造
(E-1)		(E-4)	
(E-2)		(E-5)	
(E-3)		(E-6)	

[0100]  
[Table 5]

実施例	正孔注入材料 (表4)	発光材料 (表3)	電子注入材料 (表4)	発光輝度 (cd/m <sup>2</sup> )	最大発光輝度 (cd/m <sup>2</sup> )	最大発光効率 (lm/W)
5	(H-1)	(6)	(E-2)	280	29800	2. 2
6	(H-2)	(7)	(E-3)	550	24300	3. 9
7	(H-3)	(8)	(E-1)	230	27500	2. 7
8	(H-4)	(9)	(E-5)	540	21200	3. 8
9	(H-5)	(10)	(E-6)	370	12600	1. 4
10	(H-6)	(11)	(E-4)	420	49000	2. 5
11	(H-3)	(12)	(E-2)	360	45700	4. 6
12	(H-4)	(13)	(E-3)	330	38500	4. 8
13	(H-1)	(14)	(E-5)	460	31900	2. 7
14	(H-5)	(15)	(E-4)	390	30300	3. 2
15	(H-4)	(16)	(E-5)	310	15600	2. 8
16	(H-6)	(17)	(E-5)	760	7000	1. 8
17	(H-3)	(18)	(E-6)	710	26800	2. 2
18	(H-2)	(19)	(E-5)	350	9200	2. 3
19	(H-6)	(20)	(E-2)	600	40400	4. 4
20	(H-3)	(21)	(E-2)	560	17400	3. 5
21	(H-6)	(22)	(E-4)	400	9200	1. 9
22	(H-1)	(23)	(E-1)	310	34900	3. 1
23	(H-6)	(24)	(E-2)	720	50300	5. 7
24	(H-5)	(25)	(E-1)	400	40300	5. 4
25	(H-5)	(26)	(E-5)	550	54200	4. 6
26	(H-2)	(27)	(E-6)	780	28300	2. 9
27	(H-3)	(28)	(E-6)	300	25000	2. 4
28	(H-4)	(29)	(E-6)	230	50600	4. 7
29	(H-4)	(30)	(E-5)	380	41500	4. 1
30	(H-4)	(31)	(E-4)	330	47500	3. 3
31	(H-1)	(32)	(E-5)	790	17800	2. 3
32	(H-4)	(33)	(E-4)	350	6600	1. 6
33	(H-6)	(34)	(E-5)	330	33300	3. 5
34	(H-4)	(35)	(E-3)	600	39900	3. 5
35	(H-6)	(36)	(E-2)	540	31100	3. 6
36	(H-5)	(37)	(E-6)	560	25900	2. 4
37	(H-6)	(38)	(E-5)	680	28500	2. 7
38	(H-1)	(39)	(E-6)	500	43400	2. 7
39	(H-5)	(40)	(E-3)	730	24900	2. 3
40	(H-1)	(41)	(E-2)	320	19600	2. 6
41	(H-6)	(42)	(E-4)	770	45200	4. 7
42	(H-5)	(43)	(E-6)	400	35100	2. 9
43	(H-2)	(44)	(E-1)	730	26100	2. 2

発光輝度は直流5V印加時の値

[0101]

実施例	正孔注入材料 (表4)	発光材料 (表3)	電子注入材料 (表4)	発光輝度 (cd/m <sup>2</sup> )	最大発光輝度 (cd/m <sup>2</sup> )	最大発光効率 (lm/W)
44	(H-1)	(45)	(E-4)	550	41800	4.8
45	(H-2)	(46)	(E-4)	440	29900	2.9
46	(H-3)	(47)	(E-4)	290	9700	1.6
47	(H-6)	(48)	(E-4)	270	8100	2.4
48	(H-5)	(49)	(E-6)	690	15000	1.0
49	(H-2)	(50)	(E-5)	330	48600	5.1
50	(H-3)	(51)	(E-6)	490	57300	6.1
51	(H-6)	(52)	(E-5)	280	52800	5.6
52	(H-2)	(53)	(E-2)	290	41000	5.4
53	(H-5)	(54)	(E-3)	790	30900	2.5
54	(H-3)	(55)	(E-4)	440	47800	3.9
55	(H-3)	(56)	(E-6)	280	47600	4.6
56	(H-4)	(57)	(E-2)	760	15600	1.4
57	(H-1)	(58)	(E-2)	700	19000	1.7
58	(H-4)	(59)	(E-6)	660	14600	1.8
59	(H-3)	(60)	(E-4)	420	31700	3.7
60	(H-3)	(61)	(E-5)	560	48900	4.3
61	(H-2)	(62)	(E-6)	600	44800	5.2
62	(H-4)	(63)	(E-4)	240	39200	3.7
63	(H-5)	(64)	(E-2)	330	20700	1.6
64	(H-6)	(65)	(E-1)	690	7600	1.9
65	(H-6)	(66)	(E-3)	390	9800	1.6
66	(H-5)	(67)	(E-1)	770	9200	1.7
67	(H-4)	(68)	(E-5)	660	9200	1.3
68	(H-2)	(69)	(E-6)	700	21000	2.7
69	(H-4)	(70)	(E-4)	210	34100	4.6
70	(H-2)	(71)	(E-3)	630	47300	4.4
71	(H-6)	(72)	(E-3)	660	29300	3.5
72	(H-5)	(73)	(E-4)	510	41400	5.1
73	(H-1)	(74)	(E-2)	690	18400	1.4
74	(H-5)	(75)	(E-3)	370	8200	1.9
75	(H-4)	(76)	(E-2)	570	22500	1.6
76	(H-1)	(77)	(E-4)	720	39500	4.2
77	(H-5)	(78)	(E-5)	710	10300	1.6
78	(H-2)	(79)	(E-6)	780	8900	1.2
79	(H-5)	(80)	(E-3)	250	21000	2.5
80	(H-4)	(81)	(E-6)	320	20500	1.8
81	(H-2)	(82)	(E-2)	310	30200	3.7
82	(H-4)	(83)	(E-1)	230	36600	3.9
83	(H-1)	(84)	(E-1)	580	35900	3.4

[0102] On the glass plate with an ITO electrode washed example 84, vacuum deposition of 4, 4', and the 4"-tris (N-(3-methylphenyl)-N-phenylamino) triphenylamine was carried out, and the first hole-injection layer of 25nm of thickness was obtained. Furthermore, vacuum deposition of the hole-injection ingredient (H-1) was carried out, and the second hole-injection layer of 5nm of thickness was obtained. Subsequently, vacuum deposition of the compound (2) was carried out as a luminescent material, and the luminous layer of 20nm of thickness was obtained. Furthermore, vacuum deposition of the electron injection ingredient (E-1) was carried out, and the electron injection layer of 30nm of thickness was obtained. The electrode of 150nm of thickness was formed with the alloy which moreover mixed silver with magnesium by 10:1, and the organic EL device was obtained. As for this component, green luminescence of 650 (cd/m<sup>2</sup>), the highest brightness 35000 (cd/m<sup>2</sup>), and luminous efficiency 3.6 (lm/W) was obtained by direct-current-voltage 5V.

[0103] On the glass plate with an ITO electrode washed example 85, vacuum deposition of 4, 4', and the 4"-tris (N-(1-naphthyl)-N-phenylamino) triphenylamine was carried out, and the first hole-injection layer of 25nm of thickness was obtained. Furthermore, vacuum deposition of the hole-injection ingredient (H-2) was carried out, and the second hole-injection layer of 5nm of thickness was obtained. Subsequently, vacuum deposition of the compound (3) was carried out as a luminescent material, and the luminous layer of 20nm of thickness was obtained. Furthermore, vacuum deposition of the electron injection ingredient (E-5) was carried out, and the electron injection layer of 30nm of thickness was obtained. The electrode of 150nm of thickness was formed with the alloy which moreover mixed silver with magnesium by 10:1, and the organic EL device was obtained. As for this component, bluish green color luminescence of 710 (cd/m<sup>2</sup>), the highest brightness 29000 (cd/m<sup>2</sup>), and luminous efficiency 2.7 (lm/W) was obtained by direct-current-voltage 5V.

[0104] On the glass plate with an ITO electrode washed example 86, vacuum deposition of the hole-injection ingredient (H-5) was carried out, and the hole-injection layer of 20nm of thickness was obtained. Subsequently, vacuum deposition of the compound (4) was carried out as a luminescent material, and the luminous layer of 20nm of thickness was obtained. Furthermore, vacuum deposition of the electron injection ingredient (E-2) was carried out, and the first electron injection layer of 20nm of thickness was obtained. Subsequently, vacuum deposition of the electron injection ingredient (E-5) was carried out, and the second electron injection layer of 10nm of thickness was obtained. The electrode of 150nm of thickness was formed with the alloy which moreover mixed silver with magnesium by 10:1, and the organic EL device was obtained. As for this component, orange luminescence of 120 (cd/m<sup>2</sup>), the highest brightness 15000 (cd/m<sup>2</sup>), and luminous efficiency 3.2 (lm/W) was obtained by direct-current-voltage 5V.

[0105] The organic EL device was produced by the same approach as an example 5 except using the luminous layer of 30nm of thickness which vapor-deposited one sort in the compound (5) of Table 3, and the compound of Table 6 by the weight ratio of 100:1 as 87 to example 90 luminous layer. The luminescence property of this component is shown in Table 7. All the organic EL devices of this example have a high brightness property more than highest brightness 20000 (cd/m<sup>2</sup>), and were able to obtain the target luminescent color.

[0106]

[Table 6]

化合物	化学構造	化合物	化学構造
(D-1)		(D-4)	
(D-2)		(D-5)	
(D-3)		(D-6)	
(D-7)			

[0107] The organic EL device was produced by the same approach as an example 5 except using the luminous layer of 30nm of thickness which vapor-deposited one sort in the compound (27) of Table 3, and the compound of Table 6 by the weight ratio of 100:1 as 90 to example 94 luminous layer. The luminescence property of this component is shown in Table 7. All the organic EL devices of this example have a high brightness property more than highest brightness 20000 (cd/m<sup>2</sup>), and were able to obtain the target luminescent color.

[0108] On the glass plate with an ITO electrode washed example 95, vacuum deposition of the hole-injection ingredient (H-2) was carried out, and the hole-injection layer of 30nm of thickness was obtained. Subsequently, vacuum deposition of a 4 and 4'-screw (beta and beta-diphenyl vinyl) biphenyl and the luminescent material (1) of Table 3 was carried out by the weight ratio of 100:5 as a luminous layer, and the luminous layer of 30nm of thickness was obtained. Furthermore, vacuum deposition of the electron injection ingredient (E-3) was carried out, and the electron injection layer of 30nm of thickness was obtained. The electrode of 150nm of thickness was formed with the alloy which moreover mixed silver with magnesium by 10:1, and the organic EL device was obtained. As for this component, blue luminescence of 480 (cd/m<sup>2</sup>), the highest brightness 28000 (cd/m<sup>2</sup>), and luminous efficiency 3.1 (lm/W) was obtained by direct-current-voltage 5V.

[0109] The organic EL device was produced by the same approach as an example 95 except using the luminous layer of 30nm of thickness which vapor-deposited one sort in tris(8-hydroxyquinolinate)aluminium and the luminescent material of Table 3 by the weight ratio of 100:3 as 96 to example 108 luminous layer. The luminescence property of this component is shown in Table 7. All the organic EL devices of this example had the high brightness property more than highest brightness 20000 (cd/m<sup>2</sup>).

[0110]

[Table 7]

実施例 (表3, 6)	化合物	発光輝度 (cd/m <sup>2</sup> )	最大発光輝度 (cd/m <sup>2</sup> )	最大発光効率 (lm/W)
87	(D-1)	720	78400	8.1
88	(D-2)	310	53700	4.5
89	(D-3)	250	39800	4.8
90	(D-4)	830	37100	3.9
91	(D-5)	260	55200	5.2
92	(D-6)	480	29200	2.3
93	(D-7)	800	37800	3.8
94	(D-8)	810	27700	2.4
96	(2)	390	58000	6.2
97	(4)	250	29600	3.4
98	(14)	220	61800	5.1
99	(15)	160	54400	3.7
100	(23)	240	46700	3.8
101	(36)	870	55200	5.9
102	(41)	560	26500	4.1
103	(54)	830	35300	3.9
104	(55)	870	59200	6.7
105	(58)	210	24500	2.1
106	(64)	640	23800	3.1
107	(67)	660	20700	1.9
108	(79)	550	25700	2.7

発光輝度は直流通5V印加時の値

[0111] The organic EL device shown by this example is more than 5000 (cd/m<sup>2</sup>) as luminescence brightness, and was able to acquire high luminous efficiency altogether. About the organic EL device shown by this example, when carrying out continuation luminescence by 3 (mA/cm<sup>2</sup>), luminescence stable for 1000 hours or more could be observed, and most dark spots were not observed. The organic EL device which used the organic EL device ingredient of this invention as a luminescent material, Since the fluorescence quantum efficiency of luminescent material was very high, in the component which used this luminescent material, the maximum luminescence brightness and the maximum luminous efficiency were able to be raised by attaining high brightness luminescence in a low current seal-of-approval field, and using a doping ingredient in a luminous layer in addition to the compound of a general formula [1], a general formula [4], or a general formula [5]. Furthermore, the light emitting device of the different luminescent color was able to be obtained by adding the

doping ingredient with which fluorescence colors differ to the compound which is the luminescent material of this invention.

[0112] The organic EL device of this invention attains improvement in luminous efficiency and luminescence brightness, and reinforcement, and does not limit the component production approaches used collectively, such as luminescent material, a doping ingredient, a hole-injection ingredient, an electron injection ingredient, a sensitizer, resin, and an electrode material.

[Effect of the Invention] The organic EL device which used the organic EL device ingredient of this invention as a luminescent material was able to show luminescence of the high brightness in high luminous efficiency compared with the former, and was able to obtain the long lasting organic EL device. the organic EL device formed of an organic EL device boiling further at least the compound shown by this invention by the above, and using it and the component configuration of this invention became possible [ producing easily high brightness, high luminous efficiency, and a long lasting organic EL device ].

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[Translation done.]